The Journal of the American Association of Zoo Keepers, Inc.

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Animal Keepers' Forum

Special Issue Dedicated to Gorillas | February and March 2014 | Volume 41, Nos. 2 & 3

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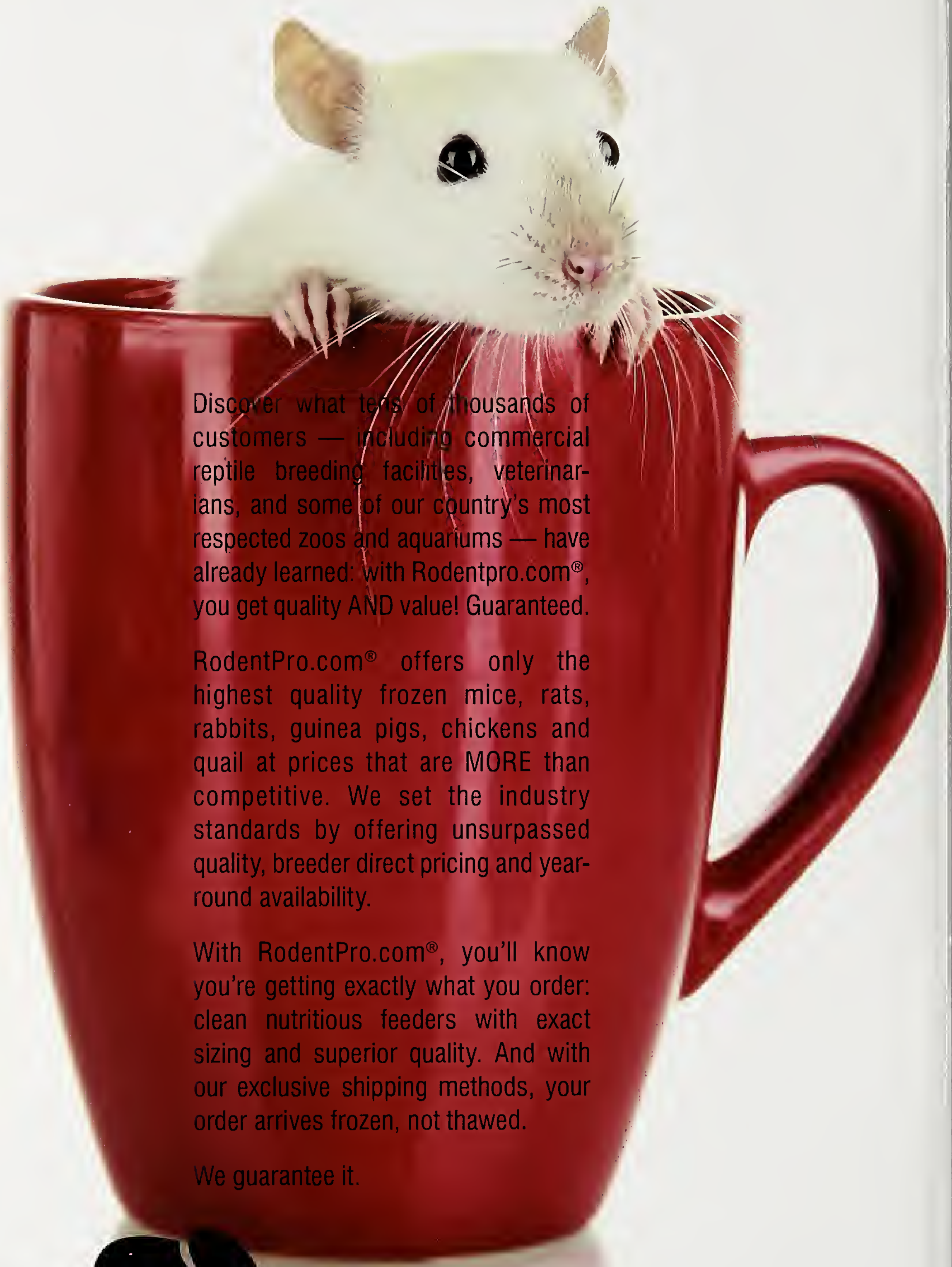

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MISSION STATEMENT

American Association of Zoo Keepers, Inc.

The American Association of Zoo Keepers, Inc. exists to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.

About The Cover

This month's cover comes from Mehgan Murphy of Smithsonian's National Zoo. The photo features Mandara, the mother of six offspring at Smithsonian's National Zoo, sub-adult male Kwame, and young female Kibibi. Both Kwame and Kibibi are offspring of Mandara. Mandara is named after a mountain range in Cameroon, and she is the dominant female of the National Zoo's group.

Gorillas are managed as intensively as any species in the zoo industry. This issue of the *AKF* highlights some of the outstanding and innovative work being performed by AAZK members to conserve the sustainability of gorilla populations both *in situ* and ex *situ*. From advancements in nutrition, to behavioral management, new innovations in veterinary care, to the conservation of wild gorillas, this issue of the *AKF* highlights the diverse skills that AAZK members use to conserve wild gorillas and advance care and welfare for our zoo population.

Dedicated issues of the *AKF* are very popular throughout the zoo industry, because they are a great example of the passion and dedication that zoo professionals have for animal care and conservation. The editors would like to thank all of the authors who took the time to share their expertise. The sharing of information and knowledge is critical to the advancement of professional animal care. We would also like to thank our sponsors, the Cleveland Chapter of AAZK, Fort Worth Zoo, Georgia Chapter of AAZK, National Capital Chapter of AAZK and Rocky Mountain Chapter of AAZK. Your support made this publication possible. Thank You! *The Editors*

Articles sent to ***Animal Keepers' Forum*** will be reviewed by the editorial staff for publication. Articles of a research or technical nature will be submitted to one or more of the zoo professionals who serve as referees for ***AKF***. No commitment is made to the author, but an effort will be made to publish articles as soon as possible. Lengthy articles may be separated into monthly installments at the discretion of the Editor. The Editor reserves the right to edit material without consultation unless approval is requested in writing by the author. Materials submitted will not be returned unless accompanied by a stamped, self-addressed, appropriately-sized envelope. Telephone, fax or e-mail contributions of late-breaking news or last-minute insertions are accepted as space allows. Phone (330) 483-1104; FAX (330) 483-1444; e-mail is shane.good@aazk.org. If you have questions about submission guidelines, please contact the Editor. Submission guidelines are also found at: aazk.org/akf-submission-guidelines/.

Deadline for each regular issue is the 3rd of the preceding month. Dedicated issues may have separate deadline dates and will be noted by the Editor.

Articles printed do not necessarily reflect the opinions of the ***AKF*** staff or the American Association of Zoo Keepers, Inc. Publication does not indicate endorsement by the Association.

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FROM THE PRESIDENT

"Only if we understand, can we care. Only if we care, we will help. Only if we help, we shall be saved."
—Jane Goodall, Jane Goodall: 40 Years at Gombe

"Unless you try to do something beyond what you have already mastered, you will never grow."
— Ralph Waldo Emerson

Dedicated *AKF* issues remind us all too well that our profession can at times be very specialized, requiring a certain level of subject matter expertise in order to give proper care to the animals in our charge. Whether it's great apes, big cats, aquatics, entomology, hoofstock, birds, or reptiles, concentrating on a focused discipline provides a skill level that carries beyond basic animal care. As readers of this issue will see, innovations in animal care are a product of such concentrated knowledge.

Before going any further, I may need to clarify myself here; specialized knowledge and general knowledge are complimentary functions of the animal care profession. And, without waxing philosophical here, the generalists are specialists of a different nature. Ask any shift keeper who works as relief to multiple areas and they will tell you it takes a special skill as well as versatility to be able to move from one area to the next, working with different animals each day.

Our Association values both specialized and general animal care knowledge and is working towards both a quantification and qualification of these skills. Over the next couple of years, our focus on professional development will adopt both conference venues and distance learning formats in order to provide opportunities for members to focus on specialized skills sets at both the conference and on-line settings. Plans are underway to offer 12-hour workshops at our conferences, presented over a 3-4 day period, supplemented by an online summary and assessment. These workshops will provide specialized skills in such disciplines as:

- Hospital/Quarantine Keeper
- Ungulate Keeper
- Avian Keeper
- Carnivore Keeper
- Small Mammals Keeper
- Reptile/Amphibian Keeper
- Primate Keeper

The issuance of certificates for each of these skill levels achieved will both quantify (the number of hours of instruction) and qualify (through assessment) each individual who participates in the workshops. The online review and evaluation will indicate that the user has a proficient subject matter knowledge based on a passable score. Your certificate, once issued can then be sent to your director, curator, or manager. The take home value of your professional development will no doubt have a greater institutional value through this qualification and your immersion in a specific topic of animal care will greatly benefit your animals.

In addition, we will also offer the same type of workshops covering the core elements of zoo keeping and advanced skills in zoo keeping. These will establish foundational tracks for the future of standardized learning in our Association. Upcoming plans also include online access to these workshops as well as a summary course, assessment, and certificate. Individual professional development will take on a new direction and meaning, providing animal care professionals with the opportunity to track and plan their future as well as utilize these skills both in the field and on paper.

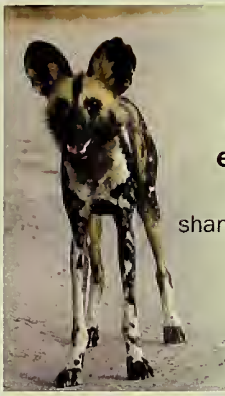
Whether specializing in a particular discipline or working in a general field, AAZK endeavors to provide standardized training in a way that benefits the individual, the institution, and the profession. It's an argument easily made: standardized professional development is beneficial to all, whether specializing based on taxa or developing stronger generalized skills.

That's our commitment to you and we're sticking to it.

As always, I welcome your thoughts and input. E-mail me at bob.cisneros@aazk.org , I would love to hear from you.

Bob Cisneros

COMING EVENTS



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shane.good@aazk.org

April 13-18, 2014
ABMA's 14th Annual Conference
Dallas, TX
For more information go to:
theabma.org.

April 29 - May 2, 2014
African Painted Dog Conference
Chicago, IL
This conference will be hosted by the Chicago Zoological Society at Brookfield Zoo.
For more information and to register please visit:http://www.czs.org/czs/ APDconference

June 20-26, 2014
International Gorilla Workshop
Atlanta, GA
Sponsored by Zoo Atlanta
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www.igw2014.wordpress.com.

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Orlando, Florida
For more information, go to
turtlesurvival.org.

September 8-12, 2014
AAZK National Conference
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September 10-15, 2014
International Wild Waterfowl Association Conference
Salt Lake City, UT
For more information go to:
http://www.wildwaterfowl.org.

September 12-18, 2014
AZA National Conference
Orlando, FL
Hosted by:
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The Seas, and
SeaWorld Orlando.
For more information go to:
aza.org.

October 6-8, 2014
3rd International Flamingo Symposium
San Diego, CA
Hosted by SeaWorld San Diego
For more information contact
laurie.conrad@SeaWorld.com.

2014 AAZK AWARDS NOMINATIONS OPENED

The American Association of Zoo Keepers AAZK Awards Committee is accepting nominations for:

- Lifetime Achievement Award
- Jean M. Hromadka AAZK Excellence in Animal Care Award
- The Lutz Ruhe Meritorious Achievement — AAZK Professional of the Year Award
- Lee Houts Enrichment Excellence Award
- Certificate of Merit for Zoo Keeper Education
- Certificate of Excellence in Exhibit Renovation
- Certificate of Merit in Conservation
- Mazuri Animal Nutrition Award

Awards will be presented at the 2014 AAZK Conference in Orlando, Florida. The deadline for nominations is 1 May 2014. Information concerning the qualifications, nomination procedure, selection procedure and an explanation of the awards may be obtained at janet.mccoy@aazk.org.

AMERICAN ASSOCIATION of ZOO KEEPERS

Membership with the American Association of Zoo Keepers includes a subscription to *Animal Keepers' Forum* and free or discounted admission to many zoos and aquariums in the U.S. and Canada.

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FIRST CALL FOR PAPERS

We are pleased to host the 2014 National AAZK Conference and our theme "Keepers Making a World of Difference" will highlight how zoo and aquarium professionals work to advance animal care and conservation.

Papers:
Authors will be allowed 15 minutes for a presentation with five minutes of Q & A immediately following. Abstracts should focus on the conference theme including innovative approaches and best practices in the areas of husbandry, animal welfare, conservation, education, enrichment and training.

Posters:
Posters will be on display throughout the conference in the Vera Cruz C Exhibit Hall with a scheduled Q & A session to be determined.

Guidelines for Abstracts:
Abstracts should be no more than 250 words and submitted as a Microsoft Word® document via e-mail to: pdc@aazk.org

Please include the following information:

- Name of the authors and presenter
- Institution/Affiliation
- Position/Title
- Title of Work (please specify poster or paper)
- AV requirements
- Contact information (please include e-mail)

Deadline for Abstracts is 1 May 2014
Authors will be notified, regarding acceptance, by 1 June 2014. All papers must be received by 15 July 2014 to be included in the conference program. Please contact pdc@aazk.org with any questions.

VENUE/ACCOMMODATIONS

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Please call 407-939-4686 or go to: http://www.mydisneymeetings.com/aazk2014/ to make a room reservation.

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PRE- AND POST-CONFERENCE TRIPS

Our Pre-Conference Trip is going to Busch Gardens and is being hosted by the Tampa Bay AAZK Chapter with details to follow.

Our Post-Conference Trip is an invitation to attend part or all of the AZA Conference. Perhaps you are interested in attending a TAG meeting. Meetings are scheduled the two days following the end of the AAZK Conference. Daily and Full Registration discounts will be available, with details to follow.

PROGRAM

Lunch, Morning and Afternoon Refreshment Breaks will be provided (Except Zoo Day) Our Program and Icebreaker details are still being finalized with details to follow.

Tentative Schedule (Subject to Change)

September 8	Icebreaker
September 9	Papers, Workshops, BFR Presentations/Rally and Silent Auction
September 10	Papers, Workshops and Awards Luncheon
September 11	Zoo Day
September 12	Papers, Workshops, Town Hall and Banquet

EXHIBITOR INFORMATION

Our Exhibitors will be in the spacious Vera Cruz C Exhibit Hall. Our Poster Presentations will also be displayed here.

Prices

The Exhibition Rates for the 2014 AAZK Conference are:

Non-Member	$250.00
Member	$125.00
Conservation Partner	$75.00
Conference and/or Workshop Sponsor	$0.00

AUCTION

Do you have an item for the Auction? All monies generated from the silent and live auctions will go to AAZK National to help support the Association and the programs that benefit YOU. Please leave room in your suitcase to bring an auction item. A few examples include zoo memorabilia, animal themed items, jewelry, gift certificates, animal and human artwork and photographs, books, husbandry and enrichment tools and items for children.

REGISTRATION

Online Registration will be opening in March
Full Registration:

- ◊ **Members:** $235.00 (includes all paper sessions, Icebreaker, Zoo Day, Awards Lunch, Banquet, T-shirt, Conference Packet and $5.00 Carbon Offset Fee)
- ◊ **Spouse:** $235.00 (includes all paper sessions, Icebreaker, Zoo Day, Awards Lunch, Banquet, T-shirt, Conference Packet and $5.00 Carbon Offset Fee)
- ◊ **Non-members:** $285.00 (includes all paper sessions, Icebreaker, Zoo Day, Awards Lunch, Banquet, T-shirt, Conference Packet and $5.00 Carbon Offset Fee)

What is the "Carbon Offset" Fee?
For each conference registration, $5 is going to be used to offset your carbon cost of attending the conference. Details will follow.

Conference Badges must be worn at all times to enter the conference areas.

- ◊ Daily Registration
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- ◊ IceBreaker Only (Non-registered Parties)
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  Non-member/Spouse: $75.00
- ◊ Awards Luncheon Only(Non-registered Parties)
  AAZK Member/Spouse: $75.00
  Non-member/Spouse: $75.00
- ◊ Banquet Only (Non-registered Parties)
  AAZK Member/Spouse: $75.00
  Non-member/Spouse: $75.00
- ◊ Zoo Day Only (Non-registered Parties)
  AAZK Member/Spouse: $75.00
  Non-member/Spouse: $75.00

Registration deadline is August 15, 2014.

After that date registration fees will include a late fee on full or daily registrations.

- ◊ Full Conference Registration with Late Fee
  AAZK Member/Spouse: $285.00
  Non-member/Spouse: $335.00
- ◊ Daily Registration with Late Fee
  AAZK Member/Spouse: $95.00
  Non-member/Spouse: $105.00

For more information on the 2014 National AAZK Conference, please visit our website at:
www.greaterorlandoaazk.org

For questions please write us at
aazk2014conference@yahoo.com.

See You Real Soon!

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A Discussion of Biscuit-Free Diets for Gorillas

Dr. Elena Hoellein-Less
Associate Curator of Animals
Cleveland Metroparks Zoo

Many of you may have heard the term "biscuit-free diet" mentioned around your zoo, particularly if you work at an institution that houses gorillas. In this article, I discuss what a "biscuit-free diet" is, what the pros and cons of going biscuit-free are and how to implement this type of diet if it seems like a good fit for your apes.

The premise behind the biscuit-free diet was to create a diet that more closely mimicked properties of wild gorilla diets. Wild western lowland gorillas consume foods that are lower in caloric density than zoo diets, but high in fiber and water content. They need to consume a high volume of these food items in order to meet their daily caloric and nutritional needs. These diets are not only high in fiber; they are very high in a specific type of fiber called neutral detergent fiber (or NDF) that is fermented in the gorilla's large voluminous hindgut. Wild gorilla diets are also low in simple carbohydrates. In particular, dietary starch is very low in wild gorilla diets. Although wild gorillas are seasonally frugivorous, they consume approximately 30% of their diet as sugar during the fruiting season, but only 2% of their diet as sugar during the longer, non-fruiting season (Shelly Masi, pers. comm.). In contrast, zoos feed gorillas diets that are relatively calorically dense and low in volume. Items such as commercially available biscuits and items such as potatoes, yam, pasta, and rice are not only high in calories (so gorillas can get their caloric needs from a small amount of food), but they are high in dietary starch, which is not a natural component of their diet. Additionally, zoo gorilla diets provide about a third of the NDF that wild gorilla diets provide. Biscuits are formulated to provide about 25% NDF, but gorillas consume upwards of 75% NDF in the wild. Finally, the commercially available fruit (and other types of produce) that

Mokolo eating greens

Bebec going "biscuit-free"

zoos feed is very high in sugar compared to wild gorilla fruits and much lower in NDF. Commercially available fruits may provide as much as 80% sugar and are fed year-round, meaning that gorillas in zoos are consuming greater amounts of sugar than their wild counterparts.

The biscuit-free diet was designed to increase the volume and NDF of zoo gorilla diets while decreasing the starch content. The biscuit-free diet involves the removal of commercially produced biscuits from the diet; however, there is more to this diet than the removal of biscuits. Not only does removing biscuits reduce the overall starch content of the diet, it frees up calories which allows zoos to feed large amounts of low calorie produce, particularly in the form of leafy greens such as endive, dandelion greens, kale, etc. Although these greens are cultivated to contain higher amounts of sugar than more natural items like browse, they are much lower in sugar than other produce items such as fruit. Because the large amount of produce does add sugar to the diet, higher sources of sugar in the diet such as fruit are reduced significantly to keep the total sugar content of the diet from increasing. It is recommended that zoos eliminate other starchy produce items such as potatoes, yams, pasta or rice to reduce overall dietary starch. Greens are a great forage item, but unfortunately they do not contain the NDF that is essential to gorilla diets, previously provided by the biscuits. Feeding browse is a great way to increase NDF, but as many zoos do not have access to this year-round, alfalfa hay can make a great substitute. However, it is imperative that gorillas consume the stems, and not just the leaves, of the alfalfa hay. For anyone considering this diet, it is essential to at least replace the NDF gorillas were consuming on their biscuit-based diet, whether it is through browse, alfalfa hay, or another source. Finally, it is recommended that zoos provide a chewable multivitamin to replace the role of biscuits as a multivitamin in the diet. In the overall goal of achieving a more natural diet, it is strongly discouraged to feed items gorillas would not typically encounter in the wild such as dairy products. The resulting diet is higher in volume, equal to or higher in NDF depending on the amount of alfalfa consumed and lower in dietary starch.

One might wonder why mimicking properties of the wild diet, particularly high volume, high fiber and low starch, is important. Providing a higher volume diet to zoo-housed gorillas will allow for greater feeding opportunities. Zoo gorillas typically spend half the amount of time that wild gorillas spend feeding and replace that time with inactivity. Inactivity can potentially lead to boredom. Providing greater feeding opportunities can be enriching or stimulating to zoo gorillas. Providing a higher fiber diet, particularly in the form of NDF, is important because gorillas are specifically designed to physiologically ferment NDF in their hindgut. Fermentation of NDF in the hindgut of gorillas releases short chain fatty acids (SCFAs) which provides energy to the gorilla. Simple carbohydrates do not meet this need. Finally, diets high in starch are associated with obesity and type 2 diabetes in humans. As gorillas are not physiologically equipped to process starch nor have it in their natural diet, they may be especially prone to these health problems. Therefore, mimicking a natural diet can have important implications for behavior and health in zoo gorillas.

So this diet sounds great in theory, but does it work in practice? The answer is yes and no, meaning that some zoos had great success with this diet and for others there were definite pros and cons. We tested this diet at five different AZA institutions. Behaviorally, we found that an undesirable behavior in zoo gorillas, regurgitation and reingestion (R/R), was reduced by this diet change and was eliminated completely at one institution. R/R is defined as the voluntary retrograde movement of food from the esophagus or stomach into the mouth, hands or a substrate, and its subsequent consumption. This is the first research study to successfully eliminate this behavior. At some zoos, feeding increased to 50-60% of time which is comparable to wild gorilla feeding levels. However, some zoos exhibited no increase in feeding. None of the gorillas became more physically active during the study. Although many increased behavioral activity, i.e. feeding, they did not spend more time moving around their exhibit or climbing. We saw an increase in coprophagy, or eating feces, for many of the gorillas. Finally, only one institution had gorillas that performed hair plucking behavior and this behavior was reduced after the diet change.

So why was there so much institutional variation? Beyond the obvious fact that gorillas have distinct personalities and institutions vary in husbandry practices, there were two key issues that explain success with this diet: consumption and managing weight loss. At most of the zoos, consumption of this new diet was not an obstacle. The gorillas readily consumed all diet items including all of the alfalfa hay. These were the zoos where we saw the greatest reduction (and elimination) in R/R and the greatest increase in feeding. At a couple of the zoos, gorillas would eat only small amounts of the greens and in some cases did not consume any alfalfa hay. At these zoos, an increase in time spent feeding was not observed. More importantly, not consuming the entire diet, particularly the alfalfa, meant that gorillas were getting less NDF than they were getting on the biscuit-based diet. Not getting enough fiber could increase the risk for health problems. It is unclear why institutions had varying success with consumption. Anecdotally, those institutions that struggled with consumption generally hand-fed more of the biscuit diet and therefore gorillas may have not had the foraging habits needed to maintain this type of diet.

Regardless of consumption, all gorillas lost weight on this diet. Even gorillas that ate everything still lost weight. This was likely because of the low caloric density of the food items, as well as high fiber content of the alfalfa. Zoos had to feed increasing amounts of produce in order to stabilize weights. At zoos where consumption was not a problem, the only consequence of this was an increasing cost of an already expensive diet. At zoos where consumption was a problem, institutions could not simply increase the amount of produce fed, but rather had to find other diet items to feed to stabilize gorilla weights. Some zoos resorted to items such as rice and oatmeal, both of which are high in starch and calories, thus making the nutritional content of the biscuit-free diet no better than the biscuit-based diet. Others fed items such as almonds which were found to specifically increase R/R. Other items such as avocado and beans appeared to work well, but again inflated the overall cost of the diet.

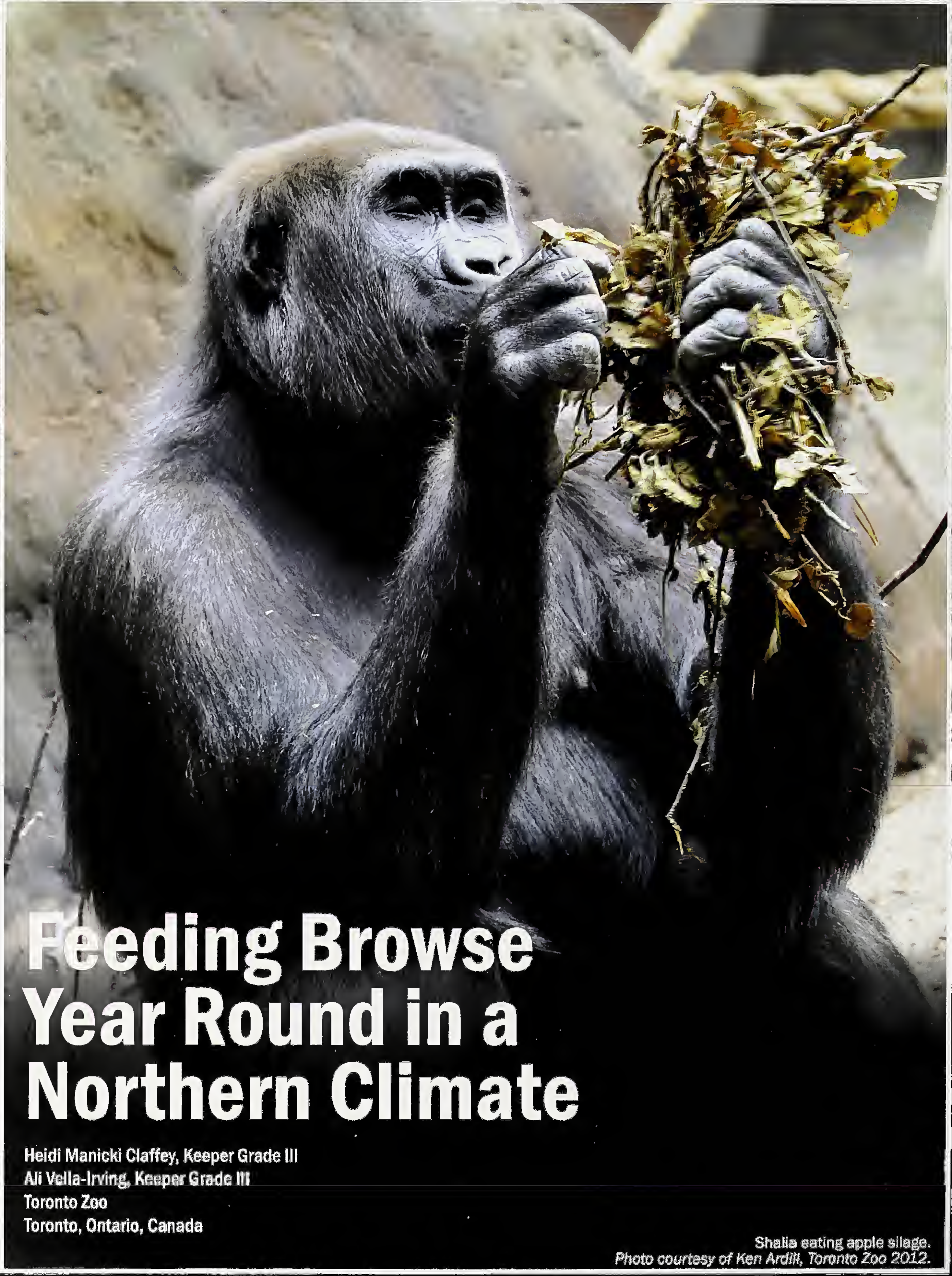
As mentioned previously, no increase in physical activity was observed. Therefore, simply feeding a higher volume diet is not a good way to promote physical exercise in gorillas. A high volume diet paired with efforts to make the gorillas work harder to obtain diet items may be useful in increasing physical activity in the future, if zoos have the exhibit complexity and/or time to make this happen. The increase in coprophagy also deserves further exploration. Current theories are that there may have simply been increased fecal output from the high fiber diet, that gorillas had to reconsume undigested alfalfa hay, that gorillas were eating the feces because of a nutritional imbalance, or that coprophagy was a feeding-motivated behavior increased because of the lack of ability (or unwillingness) to perform R/R. Interestingly, hair-plucking behavior was reduced at one institution after the biscuit-free diet change. It is unknown why this occurred; however, some possibilities might be that the increase in time spent foraging decreased the desire to hair pluck (a behavior which mimics foraging behavior). There also could have been a physiological or nutritional reason that this behavior may have decreased. One example is that starch increases systemic inflammation in humans. A low starch diet may decrease overall inflammation leading to a lower desire to perform self-directed behaviors.

At three institutions, we obtained serum samples before and after the diet change to examine health parameters such as cholesterol and insulin levels. Many of the gorillas appeared to be insulin resistant (if human reference ranges are used) prior to the implementation of the biscuit-free diet. 'Insulin resistance' is a condition in which the body produces insulin but tissues, specifically muscle, fat and liver cells, do not appropriately respond to the presence of insulin with the uptake and utilization of glucose. Insulin resistance often precedes the development of diseases like type 2 diabetes and heart disease in humans. The biscuit-free diet was successful at reducing insulin levels regardless of consumption issues in gorillas placed on the biscuit-free diet. This was not surprising as dietary starch is considered a risk factor for the development of insulin resistance in humans.

Overall, the biscuit-free diet can lead to improvements in health and behavior in zoo gorillas. If gorillas consume all of the diet items, there can be many pros to this diet including reduction or elimination of R/R, increased time spent feeding and lower serum insulin levels. However, the cons may outweigh the pros. First, this diet costs about four times as much as the biscuit-based diet to feed. Because of the low caloric density of the diet, zoos should plan to feed gorillas double the calories of their current biscuit-based diet. There should be a contingency plan in place in the event that gorillas are still losing weight even with a biscuit-free diet that is double in calories. Ideally, this would include leaving some extra cushion in the budget to allow for an increase in produce/alfalfa until gorillas stop losing weight. If gorillas reach a limit in the amount of produce/alfalfa they will consume, other items such as avocado or beans could be an alternative. It is recommended that zoos avoid feeding items high in starch such as rice or that promote R/R such as almonds. Secondly, gorillas should consume all diet items. Specifically, if gorillas do not consume all of their alfalfa (including stems) this diet may be worse for gorilla health than a biscuit-based diet. Third, it is not enough to just eliminate biscuits. Starchy root vegetables and fruit should be reduced to keep simple carbohydrates low. Alfalfa hay and multivitamins need to be fed to replace the NDF and vitamins found in biscuits. It is strongly recommended that zoos work with a nutritionist to balance any proposed biscuit-free diets. Finally, it is essential that zoos obtain regular weights on their gorillas. It is important to record if gorillas are losing or gaining too much weight and to adjust the diet accordingly. If weight loss is observed, it is recommended to drastically increase food amounts to prevent large scale weight reduction. If these four points cannot be accomplished, it is NOT recommended for a zoo to move to a biscuit-free diet.

In our multi-institutional biscuit-free study, the zoos that met the four parameters in the preceding paragraph still continue to feed biscuit-free diets and are pleased with the results. Zoos that had issues with the diet have moved back to a biscuit-based diet. Researchers at Cleveland Metroparks Zoo are continuing to research ways to reduce dietary starch and increase NDF in zoo gorilla diets in ways that may be cheaper or easier to maintain. One of our current research efforts focuses on testing a low starch (high NDF) commercial biscuit. This may provide an easier way for zoos to reduce starch in gorilla diets, but it remains to be seen whether this diet change will have the behavioral and health benefits of the biscuit-free diet.

Mokolo and the Cleveland Metroparks Zoo
still use the biscuit-free diet.



Feeding Browse Year Round in a Northern Climate

Heidi Manicki Claffey, Keeper Grade III
Ali Vella-Irving, Keeper Grade III
Toronto Zoo
Toronto, Ontario, Canada

Shalia eating apple silage.
Photo courtesy of Ken Ardill, Toronto Zoo 2012.

The Toronto Zoo's current gorilla group consists of 3.3 individuals. This species has been part of our collection since the zoo first opened in 1974. Enrichment has always been an important part of our gorilla program. Our group is very food motivated and therefore it is very difficult to find non-food-related enrichment that they are interested in. In the past, we have offered them a lot of fresh and dried fruit, fruity cereal bits, popcorn, etc. as enrichment items. Unfortunately, this combination provided the perfect conditions for all day regurgitation and reingestion (R&R) sessions. Our number one question from the public was, "Why are the gorillas throwing up their food and eating it again?" Some people even thought the gorillas were ill. After growing tired of constantly explaining this behaviour, we were motivated to eliminate, or at least greatly reduce this behaviour. We noticed that on days that browse was offered, the occurrence of R&R was greatly decreased. We just needed a way to provide browse on a daily basis.

Providing the gorillas with browse was historically considered an extra treat and delivery was not a regular occurrence. Only during the summer months were we guaranteed fresh browse due to tree pruning done around site. Fresh browse delivery during the rest of the year was sporadic at best. During the winter it was especially difficult to obtain browse because of the climate conditions. Due to the snow, it was difficult for the gardeners to access the trees to be pruned. When the snow would melt, the conditions were such that trucks and equipment would become stuck in the moist earth, which created a whole new problem. We also do not have enough trees around the zoo site which are suitable for supplying a sufficient supply for all of the animals which require browse. The indoor tropical pavilion plants can only be pruned to a certain extent. Needless to say, our browse program was lacking.

When our current nutritionist, Jaap Wensvoort, joined the zoo in 2008, we had many conversations regarding the need for regular browse delivery. He realized the importance of keeping animals enriched with browse and went to great lengths to explore all possible options. Jaap became very enthusiastic and proactive with gathering browse for the zoo animals and took this on as a project. This was the first time in the zoo's history that the nutritionist took such an active role in developing a browse program. At first, Jaap sourced out a supply of fresh corn stalks. We began giving the gorillas fresh corn stalks three times per week in addition to the sporadic browse delivery by our gardeners. Initially this worked quite well for enrichment but it soon became apparent that the corn stalks were causing a new problem of constipation. When we decided the corn stalks were not working for the gorillas, other options were explored. Jaap finally came up with a solution that was beneficial to all involved. The local owner of a non-utilized apple orchard was approached and asked if we could use the trees for browse. This was a win/win situation. The zoo received free browse and currently efforts are being made to classify the orchard as a working farm, which could benefit the land owner in regards to taxes. This orchard has become very important to our browse program and our animals.

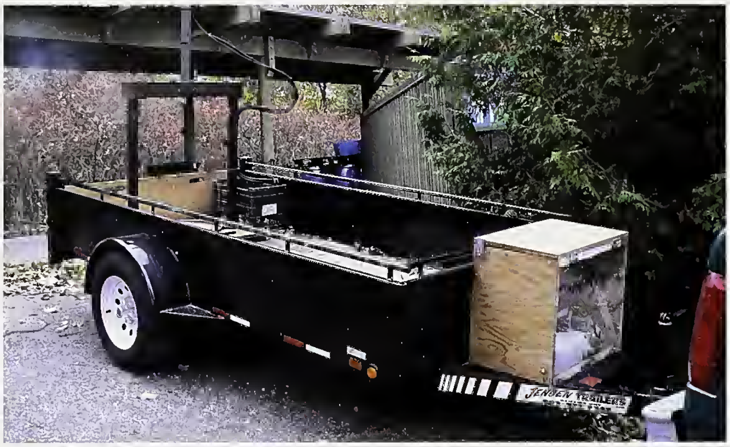
Now that we had access to a lot of browse, the next challenge was to find the manpower to harvest it. Traditionally, the job of gathering browse was left to the horticulture staff. The job of pruning this large orchard, in addition to their regular duties, proved to be too time-consuming for our already busy gardening staff. We had to come up with a solution that provided enough people with the time to harvest the browse.

The staff of the Wildlife Nutrition Centre jumped in to help, but it was not enough. Often, Keeper staff members are helping for a few hours and Jaap managed to obtain grants to employ summer students. All these people are now involved in the collection of 3-4 truck loads with fresh browse per week.

The helpers have always been able to collect enough browse to provide the gorillas with plenty of fresh browse to consume during the summer and into the fall months. This was great for the gorillas as they received more browse than they could consume, with roughly up to 30 kg being offered to them per day. However, there was still the problem of providing browse during the winter months. How could we store some of this fresh browse that was being collected during the summer months and keep it fresh so that it would last throughout the winter? Jaap devised a system which included the "Browse Press", a unique hydraulic press mounted on a trailer. The nutrition staff and helpers could preserve browse by ensiling it, which could then be stored for use during the months that fresh browse was not available.

Firstly, we needed containers in which to store the browse. Through a staff connection, we were able to obtain food-grade plastic drums which were of no use anymore to the pharmaceutical companies which previously used them to store, and ship medication. We also bought used drums from a recycling company. Two sizes of drums were obtained. We use a 120 litre-sized drum, which can hold 45 to 55 kg of browse silage, as well as the 30 litre-sized drum which can hold 14 to 18 kg of browse silage. We are not keen to use the 200 litre drums as the compaction appears not to be sufficient and they deform too much in the pressing/packing process.

The Browse trailer (with browse press mounted on it) is loaded with empty drums and brought to the orchard. Pruning is done systematically and only once every three years. Branches are cut and sorted into various sizes. Usually a chain saw or pole saw is used to cut branches up to 10 cm maximum in diameter and then with loppers. Smaller branches are pruned from those into usable sizes. The heavy branch from which the smaller pieces were cut is set aside and is used later in the winter season as stick browse. Fruit is included in the silage, but at the end of the seasons the inclusion of large apples is limited. When packing the



120 litre drums, branches of approximately 30 to 120 cm long and a maximum diameter of 1.5 to 2 cm are used. When using the 30 litre drums, shorter branches of 10 to 50 cm in length are used with a maximum diameter of approximately 1 cm.

The branches are placed into the drums and bent to fit by hand. They are then pressed down with the hydraulic press plate. Once the drum is full, it is closed with a lid and clamp and then moved forward onto the trailer, ready to be transported back to the zoo. Another empty drum will then be placed and secured under the press plate for filling.

The hydraulic press is powered by a power pack, connected to heavy duty batteries, mounted on the front of the trailer. The loading bay of the trailer holds the empty and full drums. The press is operated by a handheld switch. (Note: All technical details, including capacities are available from the Toronto Zoo Wildlife Nutrition Centre, jwensvoort@torontozoo.ca).

At the end of the browse collection session, full barrels are then transported to the storage area at the zoo. Over the next day or two, the drums are sealed with wrap-around plastic to ensure that no air can enter the barrels during the storage period.

Obviously, more manpower was required, and Jaap managed to tap into a program called "Green Teams". Major companies around the Greater Toronto Area have a mandate to do something "green" and they provide volunteer service to organizations that require help. These employees get paid by their employers but instead of working at their regular jobs, they volunteer their services for one day at places like the Zoo. After waivers are signed, the helpers are taken to the orchard. Under supervision of Wildlife Nutrition Staff, they spend a morning pruning the trees and packing the branches into the provided barrels. Enthusiastic students, keeper and horticulture staff will often help out as well. In the afternoon, the helpers are brought back to the zoo and are treated to a fresh browse feeding demonstration accompanied by a keeper talk. Since the group of helpers are traditionally quite large, they are split into two groups with one group watching the giraffes receive browse, while the other group will observes the gorillas feasting on their fresh browse. It is always very gratifying to see the smiles on the faces of the volunteers while they watch the gorillas eat the browse that the helpers have put so much labour into obtaining.

Barrels should always be stored out of direct sunlight. Once a barrel has been opened, it is essential that all the silage in the drum is fed off within a few days (1-2) if the ambient day temperature is above 10 ° Celsius. When the nights are not cold, the contents will become moldy rather quickly (within 1-3 days). If mold is present, the silage cannot be fed as the molds produce harmful toxins. We have yet to open a container to find mold but we have found yeast growing on the silage which is harmless. A good way to assess the difference between yeast and mold is through the smell test. If it smells fruity then it is fine to feed. If it smells moldy, no smell at all or there is just a "nose to it" much like the smell of moldy bread, then do not feed it. Since our winters are quite cold, it is not a problem for us to have the drums open as the daytime temperatures are unlikely to go above 4 to 8 ° Celsius, and the night-time temperatures are even colder. In the transition time to warmer temperatures we use the smaller barrels which fit into a small fridge for good keeping.

The silage has a pleasant fermented scent similar to that of apple cider. The leaves appear brown in colour but are actually quite moist. The bark also retains moisture which makes it quite desirable to the gorillas. In fact, the gorillas mainly eat the bark, and of course the fruit, however we have noticed they often tend to leave a lot of the foliage. However, they will consume every last bit of bark of the silage offered, even on the smallest of branches. This is different when fresh browse is fed, as then the gorillas eat all the leaves as well as the bark. This browse-eating activity occupies the majority of their day which makes for a quieter and more content group. Once the sticks have been stripped of their bark the gorillas will then use the branches as tools as well as for nesting material, thus providing further enrichment. The Toronto Zoo Gorilla diet was already made to contain low amounts of biscuits and biscuit-related feeds by previous Nutritionist Michelle Shaw. While the daily amount of browse was increased, Jaap additionally reduced and eliminated much of the commercial fruit (oranges, grapes, etc.) from the diet and replaced some with less sugary fruits like green beans and cucumber. We have observed that the incidence of regurgitation and reingestion has been reduced significantly since the elimination of commercial fruits and with introduction of daily fresh browse or browse silage. We think this is because they are kept busy for a greater period of time during the day and have less of a "sugar buzz". As well, we feel that the roughage not only makes them feel fuller but it also may be uncomfortable to regurgitate all or part of the bark and leaves. As part of their daily routine, the gorillas get fed several times a day and we make sure that each time they receive a renewed supply of either fresh browse or silage. A larger drum of silage will last us approximately four to five days and a smaller drum will last us approximately two days.

...the incidence of regurgitation and reingestion has been reduced significantly since the elimination of commercial fruits and with introduction of daily fresh browse...

In another development, a browse farm (i.e. land owned by the Ministry of Natural Resources but given the use to for the Toronto Zoo Browse Program) has been planted by Zoo staff and Green Teams and is already used to collect fresh browse and for making browse silage. One hectare with rows of poplar and willow were planted there, unfortunately the gorillas do not like poplar but other animals at our zoo do. Willow is also collected and offered but our fussy gorillas prefer it fresh as opposed to the silage form. At the Toronto Zoo site the horticulture staff has been proactive in planting trees to be used for browse in the future. Ironically, the zoo was built on the site of an apple orchard. Many years ago, the gardeners used to obtain browse from the remaining part of the orchard but that was made unavailable to us after it was bought by developers and houses were built on the land.

In conclusion, due to the success of this program, the gorillas receive silage everyday from November to May and fresh browse from May to October. We feel the benefits of the browse are so important to the gorilla's well-being, that we no longer consider it an optional enrichment but rather a daily requirement. Everyone understands the importance of this program and that is why we have gone to great lengths to ensure that there will always be a steady supply of browse on hand now and in the future for the animals at the Toronto Zoo.

Photos courtesy of Jaap Wensvoort, Toronto Zoo, unless noted otherwise.

Shalia eating apple silage.
Photo courtesy of Ken Ardill, Toronto Zoo, 2012.

Home-Grown *Paradise*

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ABSTRACT

Heart disease is recognized as a major cause of death in captive Western Lowland Gorillas (*Gorilla gorilla gorilla*), and it has been suggested that altering the captive diet to more closely mimic wild diets could help curb this problem. Aside from increased fiber and decreased sugars and carbohydrates, are there specific plants eaten by wild gorillas that may have health benefits? Several species of *Aframomum*, recognized both by indigenous people and western science for its medicinal properties, are eaten by wild gorillas. Chemical compounds isolated from *Aframomum* possess antifungal, antibacterial, antiplasmodial, anticarcinogenic, antiviral and antihypercholesterolemic properties. For all of these reasons, *Aframomum* is a wonderful candidate for addition to captive gorilla diets. This paper explores the potential health benefits of *Aframomum* for gorillas and details the cultivation of *Aframomum* at the Denver Zoo.

THE GRAINS OF PARADISE

Widely known as "Grains of Paradise," plants of the *Aframomum* genus are members of the Zingiberacea family, a type of wild ginger. Numerous species can be found all across sub-Saharan Africa. Traditional uses of *Aframomum* include treatment of anemia, cardiovascular diseases, chickenpox, coughs, diabetes, diarrhea, dysentery, fevers, leprosy, malaria, measles, migraines, rheumatism, sleeping sickness, smallpox, snakebites, toothaches & dental decay, tumors, worms, wounds, to control postpartum hemorrhage, and as both an aphrodisiac and for fertility control (Dokosi 1998, Iwu 1993, Kadiri 2009, Olowokudejo et al. 2008).

As early as the 13th Century, *Aframomum* was being carried across the Sahara by traders and sent to Europe via Tripoli. The Italians were the first to refer to "Grains of Paradise", the name given because of its magnificent properties but unknown origins (Simon et al. 2007). In the 14th and 15th centuries, *Aframomum* production became more important economically and Africa's Northwest coast along the Gulf of Guinea became known as the Grain Shores (BLE 2013).

Recently, *Aframomum* has been studied more rigorously in order to put scientific proof behind some of the traditional claims. Compounds found in *Aframomum* species include diterpenoids, sesquitepenoids, arylalkanoids and flavonoids (Tane et al. 2005). One compound, [6]paradol, has been shown to inhibit tumor production in mice (Surh 2006). Like other types of ginger, *Aframomum* also contains gingerols, which are chemically similar to various anti-inflammatory compounds (Dybas 2007). Western pharmaceutical and cosmetic companies seem very interested in this fact, and have begun developing both drugs and beauty products with Grains of Paradise as a prime ingredient (Dybas 2007). It's also been shown that ingestion of *Aframomum* seeds by people can lower several cardiovascular indices, indicating its potential usefulness in managing hypertension (Lawal et al. 2007). Other properties proven in the lab include antibacterial, antifungal, antihypercholesterolemic, antimicrobial, antiplasmodial and insect antifeedant activities (Doherty et al. 2010, Tane et al. 2005).

Today, Grains of Paradise are still enjoyed by people across Africa and used by Western gourmands as an interesting replacement for black pepper. (Personal Observation - To taste some for yourself, contact the author.) The uniquely flavored seeds are also used to season several well-known beers and liquors, including ©Silverback Pale Ale (brewed by Wynkoop here in Denver, with a portion of the proceeds benefiting the Mountain Gorilla Conservation Fund).

HEALTHY GORILLAS

Across Africa, gorillas have been observed eating a total of 118 medicinal plant species from 59 different families (Cousins and Huffman 2002). At some sites, gorillas eat *Aframomum* on more than 50% of days, yet the plant is considered a "low quality" herb (Doran et al. 2002). Even *Aframomum* fruit shows low digestibility (Calvert 1985), which leads me to hypothesize that gorillas are eating it not for caloric reasons but for its medicinal properties.

Aframomum melegueta is by far the most widely written about and researched species in regard to human health, but wild gorillas are known to eat at least seventeen other species: *A. albo-violaceum, A. angustifolium, A. citratum, A. daniellii, A. giganteum, A. hanburyi, A. laurentii, A. leptolepsis, A. letestuanum, A. limbatum, A. longipetiolatum, A. milbraedii, A. polyanthum, A. sanguineum, A. stipulatum, A. subsericeum* and *A. sulcatum* (Calvert 1985, Cousins and Huffman 2002, Doran et al. 2002, Fay et al. 1989, Merfield 1954, Remis et al. 2001, Rogers et al. 1990, Schaller 1963, Tutin and Fernandez 1985, Yamagiwa et al. 1994). *Aframomum* is eaten in sizable quantities as well: four species

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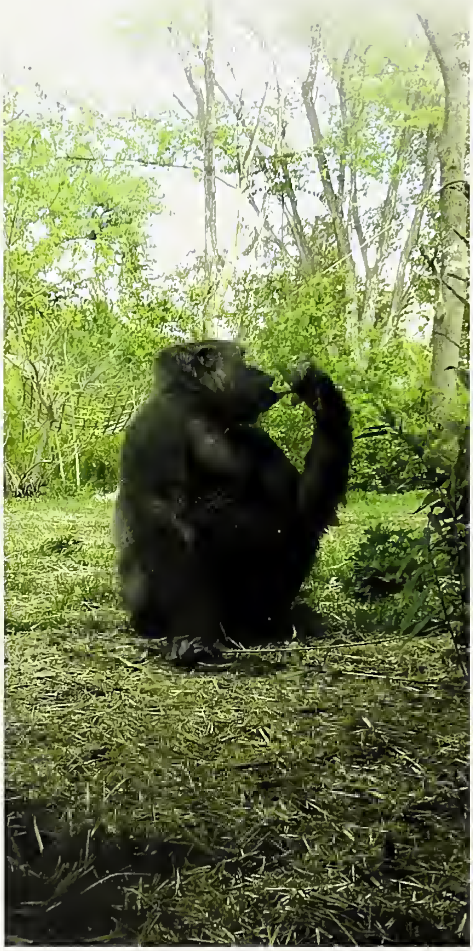
Across Africa, gorillas have been observed eating a total of 118 medicinal plant species from 59 different families



were among the 31 plants most commonly eaten by gorillas in CAR (Popovich et al. 1997). Many other African primates also enjoy *Aframomum*, so much so that it is often impossible to find a plant with fruits while walking through the forest (Personal Observation). Asian primates are not to be left out, as *Aframomum* is closely related to the genus *Amomum* (Perry 1980), which orangutans enjoy during periods of low fruit availability (Knott 1998). (Orangutans at the Denver Zoo love our *Aframomum*, as well.)

Based on the effects of the plant proven in humans, it is likely that the frequency with which *Aframomum* is eaten by gorillas indicates that it is not taken to treat specific ailments, but rather as a prophylactic, the way some people take dietary supplements. While there are no studies linking wild gorilla health directly to *Aframomum* ingestion, human-centered research suggests that some of the health indicators that differ between captive and wild gorillas could be attributed to the effects of compounds in the plant: Captive gorillas have significantly higher total cholesterol & LDL levels than wild lowland & mountain gorillas, and captive males have higher trigliceride levels than wild males, both of which may predispose them to cardiovascular disease, and may be related to diet (Schmidt et al. 2006). I hypothesize that the antihypercholesterolemic properties proven for *Aframomum* (Tane et al. 2005) may very well be one of the factors keeping these levels lower in nature.

Fifty-eight percent of necropsies on captive gorillas from a 15-year-period analyzed by Schulman et al. (1995) showed signs of fibrosing cardiomyopathy. More recently, with the advent of awake heart ultrasounds, captive gorillas have shown echocardiographic findings consistent with human disease states including left ventricular hypertrophy, diastolic noncompliance, systolic heart failure, atherosclerotic heart disease, and cardiomyopathy (Murphy et al. 2011). There are several hypothesized reasons for heart issues in captive gorillas, including viral and/or bacterial infections, nutritional deficiencies, physiologic stress, hypercholesterolemia, sedentary lifestyle, obesity, hypertension and hereditary factors (Dybas 2007; Schulman et al. 1995). Simply adding *Aframomum* to the diet could address several of these factors, thanks to the antiviral, antibacterial, antihypertension and antihypercholesterolemic effects that have been proven in humans (Doherty et al. 2010; Lawal et al. 2007; Tane et al. 2005). Adding more of any kind of browse to the diet, *Aframomum* or other, could help address some of these issues as well: Zoo diets contain much less fiber than wild diets, yet higher fiber diets for gorillas have been shown to reduce insulin and cholesterol levels (Less 2012, Popovich et al. 1997).

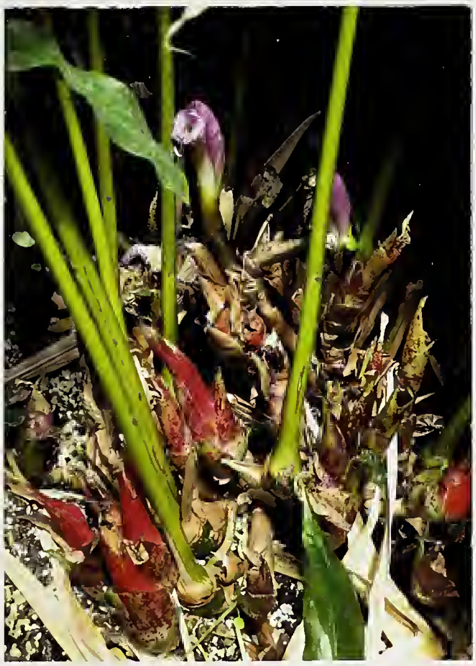
GROW YOUR OWN

The Denver Zoo's interest in *Aframomum* began after members of the horticulture crew read Cheryl Lyn Dybas' 2007 article, "Out of Africa: A Tale of Gorillas, Heart Disease...and a Swamp Plant." Many in the zoo community have now read this article and been won over by Dybas' convincing argument, but not many of us are feeding *Aframomum* yet. For some, the seeds have been difficult to source. Others have not been successful growing the plant after finding the seeds, while others are discouraged (or simply slowed in their progress) by the plant's extremely sluggish growth. Hopefully, the following paragraphs will be useful in solving many of these problems.

Denver Zoo Field Superintendant Karen Kielpikowski successfully obtained viable *Aframomum* seeds from a wholesaler in West Africa that was found on www.alibaba.com. (The wholesaler normally sells only by the ton, but Kielpikowski was able to obtain a sample order of only one pound.) If seeds are unavailable, see the following paragraphs pertaining to young plants.

To improve the chances of germination, Denver Zoo Curator of Tropical Plants Gary Davis recommends soaking seeds 12-24 hours in warm water and then scarifying. To scarify the seeds, rub a small section of each with sandpaper until the inner layer is visible. Plant in a well-draining potting mix, and plant a lot of them since sometimes only 50% or fewer will germinate. Davis suggests two seeds per 3" pot in a 36-pot tray. Germination will be slow, so be patient – it can take 1-2 months! To speed up this process as much as possible, cover the tray with a plastic lid (to help maintain humidity) and place on top of a heating pad set at 22°C (72°F).

After the seedlings are a few inches tall, transplant them into incrementally larger pots, with 3-5 plants now able to share a larger pot. Ultimately, growing many plants together in a planter 2' x 4' or larger can work very well. Growth remains slow – it took almost two years



Denver Aframomum plant with flowers, rhizomes and small fruits

The leaves of the Denver Aframomum

before Denver's plants were big enough to start harvesting browse for the gorillas; another good reason to start with a lot of seeds. However, once the plant is large enough to start sending out creeping rhizomes, harvesting stems and leaves is not detrimental, and new shoots will grow in to replace the harvested portions.

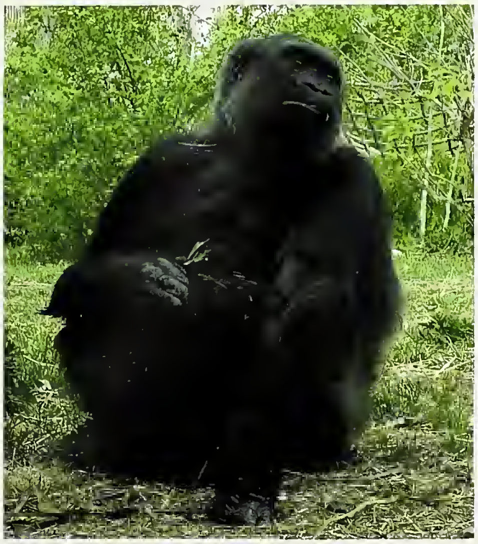
To speed the process along further, starting with a fully rooted plant rather than a seed could be desirable. Kielpikowski and Davis were successful obtaining a few "divisions" from the Denver Botanic Gardens. Though the Denver gardens do not have a large enough supply to provide plants to other zoos (only a small patch is maintained in one of the conservatories), the idea is presented here to encourage readers to approach whatever botanic garden or university herbarium might be close to them. Some commercial nurseries have begun growing *Aframomum*, as well. Floraland Farms and Nurseries in Florida has both *A. melegueta* and *A. danielli* available for purchase in wholesale quantities that can be shipped almost anywhere.

Once you have some plants started, finding enough space is the next concern. Since *Aframomum* grows well and spreads nicely in large planters, lots of space is ideal. However, the plant is not cold-tolerant, so that makes greenhouse space necessary for northern zoos. In Denver, most of our *Aframomum* grows in the greenhouse complex, but we've also taken advantage of planters in the Tropical Discovery (reptiles, amphibians and fish) building, where the plant is grown as an ornamental and harvested only infrequently. Even if your zoo does not have a greenhouse available, get creative – planters can work well in a sunny office space or almost anywhere a houseplant would thrive.

Currently, small amounts of leaves and stems are harvested for the Denver gorillas on a weekly/bi-weekly basis. We have many plants in various stages of maturity, and the hope is that a much larger amount of *Aframomum* will be available for the gorillas in the future. We have not been successful in growing mature fruits yet: While the flowers bloom and fruits develop and appear to ripen, they are hollow and devoid of seeds or pulp. One possibility is that we do not have the proper pollinators, since insects are excluded from the greenhouse. A warm-weather zoo with some space to devote to growing *Aframomum* outside may be more successful in obtaining mature fruits, reportedly the favorite part of the plant for some gorilla populations.

CONCLUSION

Though some may advocate for more testing of *Aframomum* before suggesting its addition to the diets of captive gorillas, we at Denver Zoo are not of this mindset. While we would certainly cooperate in a larger study if another institution wanted to examine long-term effects the plant may have on the health of captive populations, our veterinary and animal care staff have seen enough proof in the literature to feel confident in feeding this natural food to Denver's gorillas. Even if *Aframomum* did not possess the miraculous qualities sometimes attributed to it, we feel that as a staple in the diet of wild gorillas it is unlikely to be a harmful addition to captive diets. We find it rewarding to be among the small handful of zoos feeding African plants to gorillas, and they seem to enjoy it as well, so that alone makes it worth the effort of cultivation.



REFERENCES

Biodiversity Library Exhibition (BLE). 2013. Biodiversity Library Exhibition. Sourced from www.biodiversityexhibition.com on January 26th 2013.

Calvert, J.J. 1985. Food selection by western gorillas (*Gorilla gorilla gorilla*) in relation to food chemistry. *Oecologia* 65:236-246.

Cousins, D., and M.A. Huffman. 2002. Medicinal Properties in the Diet of Gorillas: An Ethno-Pharmacological Evaluation. *African Study Monographs* 23(2):65-89.

Doherty, V.F., Olaniran, O.O. and U.C. Kanife. 2010. Antimicrobial Activities of *Aframomum melegueta* (Aligator Pepper). *International Journal of Biology* 2(2):126.

Dokosi, O.B. 1998. *Herbs of Ghana*. Ghana Universities Press, Accra.

Doran, D.M., McNeilage, A., Greer, D., Bocian, C., Mehlman, P. and N. Shah. 2002. Western Lowland Gorilla Diet and Resource Availability: New Evidence, Cross-Site Comparisons and Reflections on Indirect Sampling Methods. *American Journal of Primatology* 58(3):91-116.

Dybas, C.L. 2007. Out of Africa: A Tale of Gorillas, Heart Disease...and a Swamp Plant. *Bioscience* 57(5):392-397.

Fay, J.M.M., Agnagna, J., Moore, J. and R. Okoko. 1989. Gorillas (*Gorilla gorilla gorilla*) in the Likoula swamp forests of North Central Congo: Preliminary data on populations and ecology. *International Journal of Primatology* 10(5):477-486.

Iwu, M.M. 1993. *Handbook of African Medicinal Plants*. CRC Press, Boca Raton, Florida.

Kadiri, A.B. 2009. An Examination of the Useage of Herbal Contraceptives and Abortifacients in Lagos State, Nigeria. *Ethnobotanical Leaflets* 13: 140.

Knott, C. 1998. Orangutans in the wild. *National Geographic Magazine*, 194 (2): 30-57.

Lawal, B.A.S., Aderibigbe, A.O., Essiet, G.A. and A.D. Essien. 2007. Hypotensive and Antihypertensive Effects of *Aframomum melegueta* Seeds in Humans. *International Journal of Pharmacology* 3(4):311-318.

Less, E. H. 2012. Adiposity in Zoo Gorillas (*Gorilla gorilla gorilla*): The Effects of Diet and Behavior. PhD Thesis, Case Western University.

Merfield, F.G. 1954. The Gorilla of the French Cameroon. *Zoo Life* 9(3):84-94.

Murphy, H.W., Dennis, P., Devlin, W., Meehan, T. and I. Kutinsky. 2011. Echocardiographic Parameters of Captive Western Lowland Gorillas (*Gorilla gorilla gorilla*). *Journal of Zoo and Wildlife Medicine* 42(4):572-579.

Olowokudeju, J.D., Kadiri, A.B. and V.A. Travih. 2008. An Ethnobotanical Survey of Herbal Markets and Medicinal Plants in Lagos State of Nigeria. *Ethnobotanical Leaflets* 12: 851-865.

Perry, L.M. 1980. *Medicinal Plants of East and South East Asia*. MIT Press, Cambridge, Massachussets.

Popovich, D.G., Jenkins, D.J., Kendall, C.W., Dierenfeld, E.S., Carroll, R.W., Tariq, N. and E. Vidgen. 1997. The Western Lowland Gorilla Diet has Implications for the Health of Humans and Other Hominoids. *Journal of Nutrition* 127:2000–2005.

Remis, M.J., Dierenfeld, E.S., Mowry, C.B., and R.W. Carroll. 2001. Nutritional Aspects of Western Lowland Gorilla (*Gorilla gorilla gorilla*) Diet During Seasons of Fruit Scarcity at Bai Hoku, Central African Republic. *International Journal of Primatology* 22(5):807-836.

Rogers, M.E., Maisels, F., Williamson, E.A., Fernandez, M., and C.E.G. Tutin. 1990. The Diet of Gorillas in the Lope Reserve, Gabon: A Nutritional Analysis. *Oecologia*, 84: 326-339.

Schaller, G.B. 1963. *The Mountain Gorilla: Ecology and Behaviour*. University of Chicago Press, Chicago.

Schmidt, D.A., Ellersieck, M.R., Cranfield, M.R. and W. Karesh. 2006. Cholesterol values in free-ranging gorillas (*Gorilla gorilla gorilla* and *Gorilla beringei*) and Bornean orangutans (*Pongo pygmaeus*). *Journal of Zoo and Wildlife Medicine* 37(3):292-300.

Schulman, F.Y., Farb, A., Virmani, R. and R.J. Montali. 1995. Fibrosing Cardiomyopathy in Captive Western Lowland Gorillas (*Gorilla gorilla gorilla*) in the United States: A Retrospective Study. *Journal of Zoo and Wildlife Medicine* 26(1):43-51.

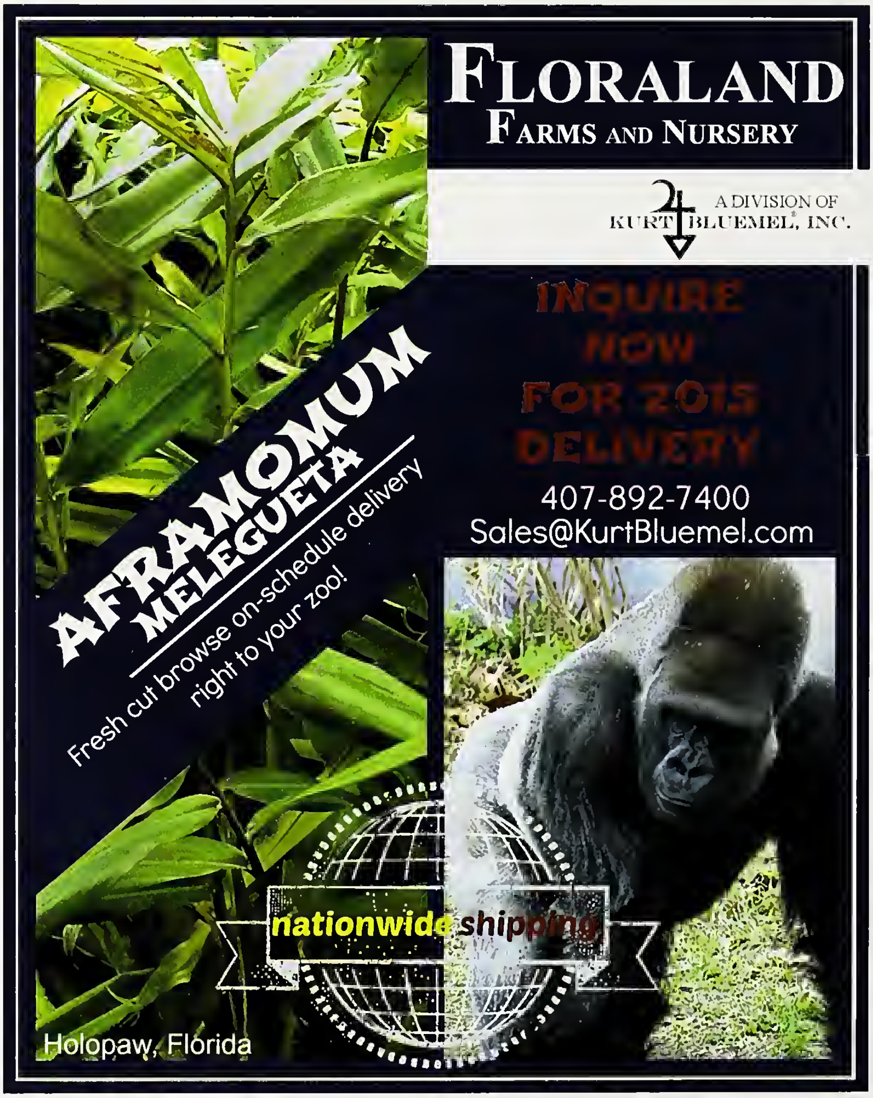
Simon, J.E., Koroch, A.R., Acquaye, D., Jefthas, E., Juliani, R. and R. Govindasamy. 2007. Medicinal Crops of Africa. In: *Issues in New Crops and New Uses*. Janick, J. & Whipkey, A. (eds). ASHA Press, Alexandria, Virginia.

Surh, Y.J. 2006. Chemopreventive Phenolic Compounds in Common Spices. In: *Carcinogenic and Anticarcinogenic Food Components*. Baer-Dubowska, W., Bartoszek, A., Malejka-Giganti, D. (eds). CRC Press, Boca Raton, Florida.

Tane, P., Tatsimo, S.D., Ayimele, G.A., and J.D. Connolly. 2005. Bioactive Metabolites from Aframomum Species. 11th NAPRECA Symposium Book of Proceedings, Antananarivo Madagascar. 214-223.

Tutin, C.E.G., and M. Fernandez. 1985. Foods Consumed by Sympatric Populations of *Gorilla g. gorilla* and *Pan t. troglodytes* in Gabon: Some Preliminary Data. *International Journal of Primatology* 6(1):27-43.

Yamagiwa, J., Mwanza, N., Yumoto, T. and T. Maruhashi. 1994. Seasonal change in the composition of the diet of eastern lowland gorillas. *Primates*, 35:1-14.



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Facilitating Gorilla Husbandry with Established Training and Enrichment Programs

Ricca DuCharme, Keeper III • Liz Monte, Keeper III
Disney's Animal Kingdom®
Orlando FL

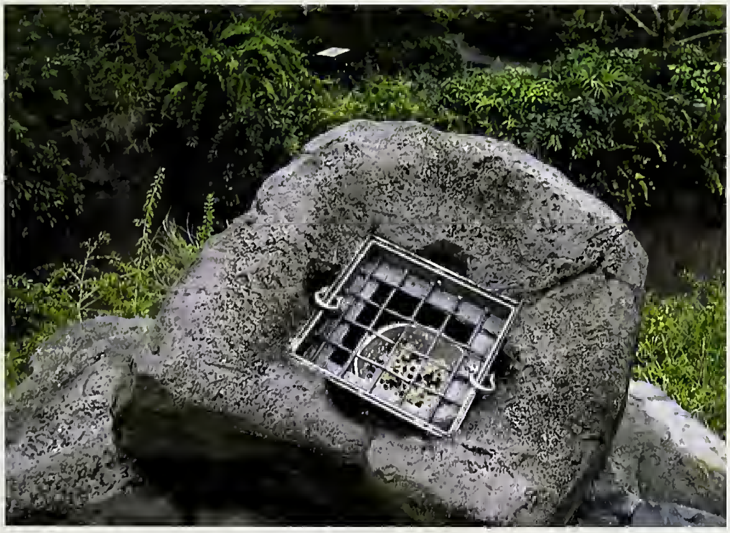
At Disney's Animal Kingdom® (DAK), we have found that multi-faceted training and enrichment programs are highly beneficial in mitigating gorilla husbandry issues. This paper will focus on how enrichment initiatives, as well as an established training program are used for managing social groups, medical management, as well as training both urgent and daily husbandry behaviors.

Managing social groups of animals can be complex. The needs of the individuals and group must be met while keeping in mind the natural composition of such groups. Bachelor gorilla groups in particular present several challenges for zoo keepers. The bachelor group at DAK was formed with four juvenile males and one silverback. As the juveniles matured we started seeing increased aggression among the group. Keepers wanted to ensure that the group had a safe outlet to redirect aggression and the ability to perform species-specific behaviors such as displaying safely. Keepers noticed that the bachelors often displayed on very large enrichment items that were used in their holding areas at night. Our goal was to give them the same opportunity on exhibit during the day, while maintaining the naturalistic look of the outdoor habitat. To accomplish this, anchors were strategically installed throughout the habitat so that keepers could secure large items such as trash cans, large boomer balls and barrels behind bushes or dead fall allowing the gorillas to redirect their aggression onto the objects rather than each other and maintaining the aesthetic integrity of the habitat.

Through the installation of puzzle feeders, we were able to manage aggression within our bachelor troop. The goal was to provide the bachelors with a means of foraging that would occupy their time and decrease contact aggression. We had an existing feeder where the gorillas spent significant time foraging. In order to increase foraging time and eliminate competition over the one feeder, we had three additional feeders installed. These were created by cutting a hole into preexisting rock structures in the exhibit. The holes were then covered and secured with a metal mesh top that keepers could take off in order to place food inside. Items such as oatmeal or mashed potatoes were offered because they required a lot of time to remove from the feeder and were favored by the gorillas. Our observations showed that in addition to time spent accessing food from the feeders, the gorillas also spent time finding and modifying suitable branches for feeder tools. Additionally, we noticed that the gorillas came back to the feeders throughout the day to forage for leftovers. This enrichment initiative was effective because it kept the gorillas engaged in an appropriate activity and resulted in less time for possible aggressive interactions.

Another instance where we found enrichment to be critical to our husbandry strategy was in mitigating infant stealing in our family group of gorillas. Novel enrichment items were used to divert the attention of Hasani, a four-year-old male, who began carrying his infant sister, Makena. Though their mother Benga was a very experienced mother, she demonstrated a lax maternal style, and began handing her newborn infant to Hasani when Makena was just two-days-old. Hasani eventually began taking the infant from his mother and often handled her inappropriately; he was very rough with her and sometimes dragged her throughout the exhibit by her leg. Due to the threat this behavior presented to the infant, the team problem-solved the situation and developed a number of strategies to mitigate the inappropriate behavior. One of the most important strategies was to ignore Hasani when he was exhibiting undesirable behaviors and reward when he exhibited desirable behaviors such as playing appropriately with her or returning

Puzzle feeder in gorilla exhibit



Zawadi utilizing puzzle feeder

Lilly climbing on wheelbarrow

her to her mother upon request. Another strategy was to increase the number of daily feedings and training sessions the gorillas received, thus making their routine less predictable and more novel. For safety purposes the water moat surrounding the habitat was drained and padded with wood wool. One of the main focuses for problem-solving the behavioral issue was to completely overhaul the enrichment program. At the time of these occurrences, DAK's animal habitats followed a strict theme, or storyline. The storyline for the gorilla habitats are that a group of researchers are camping in the area in order to study the two gorilla groups. By expanding upon this storyline keepers were able to put items such as blankets, clothing, pots, pans, water jugs, and canteens in the exhibit, since these are all items you would expect to find at a researcher's campsite. (The story is a troop of baboons raided the camp and that is why the items are spread throughout the habitat). These novel enrichment items were offered every two hours. This provided a more dynamic schedule for the gorillas as well as increasing the variability of novel items. The gorillas had to be shifted into holding in order to put out new enrichment which meant that Hasani's behavior was redirected to a constructive outlet. Hasani's inappropriate behavior diminished within a few weeks.

Several years later as Hasani matured, we found ourselves once again utilizing enrichment in order to better manage our family group. Hasani started showing aggression towards the silverback as well as the females in his family group. Although we were seeing an increase in aggression, keepers felt it was important to maintain Hasani in his natal group as long as possible in order to provide him with optimal socialization. To combat this aggression, keepers increased enrichment offerings from two times to four times a day, and included items the males could use to safely display on. In an effort to increase foraging time, puzzle feeders similar to the bachelor gorillas' feeders were utilized. Keepers also looked for ways to better utilize space in the holding area. This was achieved by hanging platforms in all of the holding areas to allow for the use of the vertical space. By making the vertical space more useable, the lighter, more agile females had easy avenues to escape from Hasani. After implementing these strategies, the aggression was reduced to a manageable level, and Hasani was able to remain in his family group another four years, until he was thirteen-years-old.

Training and enrichment have also proved useful in managing medical cases with our gorillas. Benga, a female in our family gorilla group, presented with an arm injury. The wrist was swollen and she was not using the limb to locomote or forage. Radiographs were needed in order to determine the level of injury to the arm. Typically an immobilization would be required to obtain radiographs. The staff preferred not to immobilize her for radiographs due to her advanced age. Luckily our vet staff had a portable x-ray unit. If we could find a way to use this equipment to get the radiograph then we could avoid an immobilization. By repurposing a large five-gallon water bottle that had been a previous enrichment item, keepers were able to create a radiograph sleeve. Benga was already comfortable with this item because it had been a regular enrichment item for a number of years. Utilizing an existing opening in the holding mesh from our blood pressure sleeve, the water bottle was secured to the outside of the mesh to form a contained area for her to place her arm outside of the enclosure mesh. The resulting radiograph images revealed a fracture. After showing the images to an orthopedic surgeon, we decided to allow the bone to heal without intervention, thus sparing her two immobilizations. Benga's arm was radiographed weekly for eight months to monitor its healing. It is important to note that we would not use this method with our adult male gorillas, due to their size and strength. We believe the key to our success in training this behavior was the desensitization to the presence of vet staff and large groups at routine training sessions. This strategy has been exceedingly successful in mitigating stress when medical assessments by vets or other specialists are required.

We have also found that desensitization to objects prior to shaping complex behaviors can eliminate steps and make the process easier, quicker and less stressful. Keepers introduce props such as PVC dowels and medical equipment in the

Cardiac ultrasound.
Image taken backstage at Disney's Animal Kingdom®

beginning of the training process in order to mitigate difficulties later on when they may be more critically needed. In particular, one of these behaviors that we needed to train was awake cardiac ultrasounds. This behavior became important when one of our silverbacks was diagnosed with heart issues and our vets asked us to train all five of our silverbacks in order to monitor their cardiac health. We were given eight weeks to train all five gorillas. If we could not complete the behavior then all five would require immobilizations to determine the degree of cardiac risk for each of them. We also knew that awake ultrasounds were ideal because the anesthetic agents used to immobilize the gorillas could affect the ultrasound results. We had an ultrasonographer that came in for these sessions and directed the keepers on the positioning of the probe. She also worked with the primate managers during these sessions so they were able to assist keepers during training sessions. We are now able to perform awake voluntary cardiac ultrasounds at least twice a year in order to monitor their condition and send the images to the Gorilla Health Project.

Blood pressure is another complex behavior that was facilitated by previous desensitization to medical equipment. We found that trust and the relationship with keepers was the most important factor when training this behavior, especially when inflating the cuff and asking them to hold still for a period of time while the cuff tightens around their arm. This behavior also requires two keepers which is unusual, so it was important for the gorilla to be comfortable with this. In addition to cardiac ultrasound, this is another procedure that can be impacted by anesthetic agents and better results can be achieved when measurements are collected on awake animals.

Another situation where keeper relationship along with early familiarization to props was essential was in providing dental care to Hope, one of our female gorillas. She had chronic gingivitis for several years and required daily dental care. Hope was one of our most suspicious gorillas but had prior training with props such as a spray bottle and toothbrushes. Her daily dental routine consisted of brushing her teeth with an electric toothbrush, rinsing the toothpaste and flushing her gums with mouthwash. This routine allowed us to monitor her teeth and gums daily and photographically document any changes that occurred. We also sent these photographs to our veterinarians.

The use of enrichment was significant in the treatment of our youngest gorilla Lilly. After Lilly's birth, keepers noticed she appeared to be significantly developmentally delayed. Her mother, Kashata, seemed to be compensating for her. Kashata was observed either bipedally or tripedally locomoting while carrying Lilly. Although no diagnosis was obtained, occupational and physical therapy was recommended to treat the symptoms of her lack of development. It is important to note that Kashata participated in maternal training while she was pregnant with Lilly. We were able to utilize Kashata's prior training in order to help position Lilly closer to the mesh. During Lilly's therapy sessions, a wide variety of enrichment items were used. Keepers selected items with unique textures, bright colors or items that made noise or vibrated. We also altered items by changing their temperature or taste. Each item was chosen because it served a specific function for muscle stimulation, muscle strengthening, or improved hand-eye coordination.

In addition to the therapy sessions conducted in holding, keepers wanted to extend Lilly's therapy to include her time in the habitat. Due to Lilly's unique needs, keepers were given approval to place unthemed items at the large glass viewing area of the habitat. With these new items we wanted to encourage exploration, object manipulation and movement to improve her gross motor skills. We used large items such as wheelbarrows and spools that Lilly could climb on and smaller items such as Kongs® and balls that could be thrown, picked up, or carried. These items varied daily. The addition of these novel items not only helped in accomplishing our physical therapy goals, but it also appeared to enhance the guests' experience while watching the gorillas.

As these husbandry challenges have demonstrated, basic yet multifaceted enrichment and training programs are highly beneficial to gorilla management. Both can have far reaching goals that can aid in key husbandry elements such as training, medical care and management of complex social situations. A well-established program can aid in the problem-solving of difficult husbandry situations helping to avoid unnecessary medical intervention and the dissolution of social units. Investment in such a program is vital to maintaining a comprehensive gorilla husbandry program.

Radiograph training.
Image taken backstage at Disney's Animal Kingdom®

Physical therapy session with Lilly.
Image taken backstage at Disney's Animal Kingdom®

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You Want Me To Do *WHAT* For Carrots?!
Training 1.0 Western Lowland Gorilla on the Chow-Free Diet

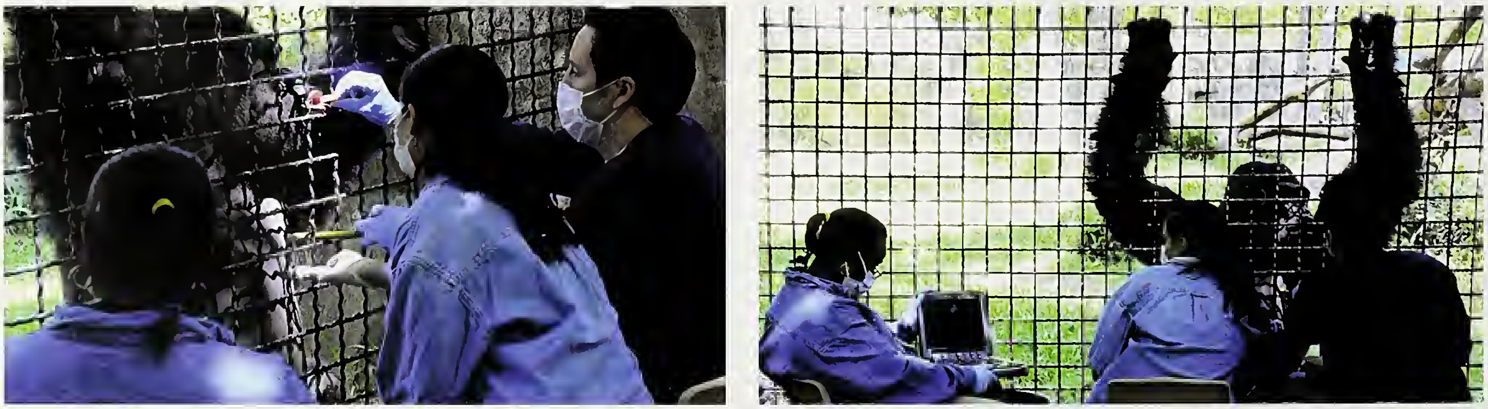
Aaron Jesue, Gorilla Keeper II
North Carolina Zoological Park • Asheboro, NC

INTRODUCTION
Since June of 2008, the Western Lowland Gorilla (WLG) troop at the North Carolina Zoo has been offered a healthier, greener chow-free diet. The goal of the diet change was to provide the gorillas with a diet low in sugar and starch, high in fiber, and which more closely approximates what gorillas eat in the wild. When making this transition, keepers learned that there would be limited "treats" allowed during training sessions. Items such as yogurt, chocolate sauce, grapes, primate biscuits, bananas, animal crackers, and other "goodies" that we were accustomed to using as rewards were removed from the diet. Keepers were required to follow the assigned diet and be more creative in achieving their operant conditioning goals. Each animal had to be assessed individually to figure out what diet foods would work best for training. This article will discuss the issues faced while training new and more complex behaviors to 1.0 WLG at the North Carolina Zoo on the low sugar, chow-free diet.

THE DIET CHANGE
Prior to his arrival at the NC Zoo in March of 2008, Nkosi was given a variety of food reinforcements: oatmeal with mixed berries, bananas, apples, oranges, grapefruit, potatoes, primate biscuits, raisins, etc. Even while in quarantine after arrival at the NC Zoo, the veterinary technicians were rewarded with a very loud grumble from a very food-motivated animal during training and enrichment sessions. Once quarantine ended, coincidentally, so did the high variety of "treats" due to the transition to the new chow free diet. His perceived favorite items were now considered "illegal contrabands," along with other items that had been a staple in the gorilla keeper food enrichment arsenal for many years. The keepers needed to change their mentality that gorillas could only do new behaviors, shift, and cooperate for novel food rewards outside of their diet. A quick transition was made to adopt the approach that a gorilla can really do anything with reinforcement from their diet.

We originally started out with apples as the preferred training item, but after a nutritionist rechecked the overall composition of the chow-free diet, she suggested removing apples and replacing them with kiwi. The gorillas quickly adjusted to the fruit exchange, and the keepers soon observed all of the gorillas successfully training for only kiwi, carrots, and the occasional "jackpot" item of air-popped popcorn. In only two months following the introduction of the chow-free diet and the limited training treats, I was able to successfully hand-inject Nkosi for

Cardiac ultrasound training on exhibit with Hospital Wiggins, Dr. Stringer, and Keeper Jesue. *Photos by Tom Gillespie*



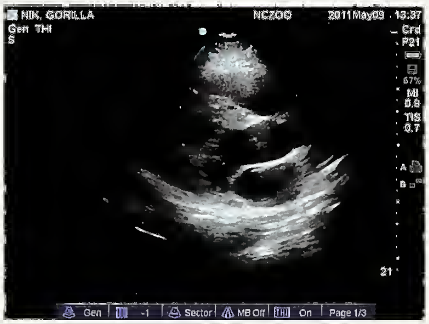
Nkosi in the "Lay Down" position, part of the cardiac ultrasound training with Dr. Stringer and Keeper Jesue. *Photo by Aaron Jesue*

Nkosi participating in "Mouthwash Training" with Keeper Jesue. *Photo by Tom Gillespie*

a medical procedure, while only using a few small pieces of fruit as a reward.

TRAINING A NEW BEHAVIOR

In May of 2010, I attended the Gorilla Workshop at the Oklahoma City Zoo. At the workshop, a presentation by Disney's Animal Kingdom gorilla keepers showed how they were able to perform a complete cardiac exam on an awake gorilla. Presenting for an ultrasound was a behavior that we had never thought to train the gorillas at our zoo. Since heart disease is so prevalent with male gorillas in captivity (and was a factor in the death of Nkosi's father, Sunshine), we thought accomplishing this training goal with Nkosi could help improve his veterinary care and management. When the idea was brought back to the North Carolina Zoo, the decision was made to immediately begin training Nkosi on cardiac ultrasound, along with TB test and blood draw. Completing these three major components through training would alleviate the need to anesthetize Nkosi for his yearly checkup.



Picture showing the chambers of the heart obtained through operant conditioning. *Photo Courtesy of Dr. Ryan DeVoe.*

Work began with desensitizing Nkosi first to a mock ultrasound probe/unit, made from PVC, jump rope, and a box. Once he was reliably presenting his chest for the mock ultrasound probe, ultrasound gel was introduced. Nkosi is a very particular gorilla; he doesn't like getting dirty, he doesn't like dirt on his food, and he especially doesn't like ultrasound gel on his chest. Desensitization to the gel took much longer than anticipated, but once he reliably allowed me to put gel on the mock probe and move it around on his chest, it was time to introduce the vet techs and vets. We are lucky at our zoo to have vets and vet techs that are interested in changing animal perceptions of only negative things happen when they are present. They are also interested in helping the keepers do anything possible to help avoid anesthetizing the animals in our collection. We scheduled weekly, and sometimes daily, training sessions in which the vets and vet techs would come to train with Nkosi to get him comfortable with the real ultrasound machine. Over the next few months, we were able to do successful ultrasound sessions and capture some initial cardiac images with the zoo's ultrasound machine.

ADJUSTMENTS TO OUR TRAINING PLAN

However, following a discussion with an ultrasound technician and vet staff, we determined some new positions that Nkosi would need to be in during the actual cardiac ultrasound training session. The new position required Nkosi to lie down on the left side of his body with his right hand holding onto the mesh above. Numerous questions arose:

1. Which holding room should this behavior be trained in to provide adequate space for him to completely lie down?
2. Can this behavior be trained both in holding and on exhibit?
3. How will Nkosi adjust to the additional time extensions to each ultrasound training session, extending from 10-15 minutes to our goal of 20-25 minutes.

Once the details were worked out, we began training with Nkosi in holding in the morning in addition to on exhibit in the afternoon. Our approach to train this position was to target his right foot extended to our left downward, his right hand up on the mesh, and another target for his left ear. Each day I would target his ear lower and lower on the mesh towards the floor. The command used was "lay down," along with my body leaning over in a similar position. He slowly started connecting the dots until he finally laid all the way down a few months later. Each day following this breakthrough, we maintained this behavior to ensure it would be reliable when we scheduled the actual procedure. Less than one year after attending the Gorilla Workshop, we successfully completed an awake cardiac ultrasound exam on Nkosi on 9 May 2011. The session lasted about 30 minutes, involved one large bowl filled with carrots, and included Jan Blackburn, the zoo's ultrasound consultant who was a new face that Nkosi had never met before while awake. We were able to capture all necessary images relating to chamber size, contractility, and blood flow patterns. When the jackpot bag was being torn open and popcorn was flying around after the session was over, a big sigh of relief was let out by the vet staff and myself. All of the extra training sessions and months of preparation had paid off.

We have come a long way over the last four years adjusting to the challenges of training while on the chow-free diet. Our current group of gorillas consists of Nkosi, Jamani, Acacia, and Olympia (1.3). All four gorillas train for both basic routine behaviors (body part presentation, shifting, trade, etc.) and more individually specialized training. Nkosi is currently training for blood draw, blood sleeve, mouth wash training, blood pressure sleeve, and TB test with the new rewards of carrots and green beans (followed by the staple jackpot of brown paper bag of air-popped popcorn); Acacia is currently working on cardiac ultrasound training; Jamani and Olympia are currently working on ultrasound training and other maternal behaviors due to their current pregnancies regulated from the Gorilla Species Survival Plan (SSP) breeding recommendations (Jamani due in July; Olympia due in October of 2012). The females train for kiwis from their diet, a luxury we cannot use for Nkosi while he is on exhibit due to issues with regurgitation and reingesting.

Almost all of the success that has occurred in training over the last four years of the chow-free diet has to be attributed to Nkosi. If it was not for his eagerness to train, ability to adapt quickly to change, and motivation for food, many of these successes would not be possible. Nkosi's introduction to training was established by the gorilla staff at the Columbus Zoo and has helped us shape him into the "rock star training" status he currently maintains here at the North Carolina Zoo. Keepers here and at many other zoos have feared that by taking away what they perceive as their animals favorite food items, you will not be able to accomplish your training goals. Our training experience with Nkosi has shown that even very challenging behaviors can be trained using limited (healthy) treats and only items found in their chow-free diet. Patience, adaptability to new ideas, and proper application of modern training techniques have proven that anything is possible and that new ideas and concepts can outweigh the perceived notions and assumptions of the past.

Special thanks to: Supervisor Chris Goldston and all of the Pavilion/Gorilla Keepers, Curator Ken Reininger, Curator Rich Bergl, Curator Terry Webb, Tom Gillespie for use of his photos, Dr. Ryan DeVoe, Dr. Betsy Stringer, Hospital Vet Techs Gisela Wiggins and Dave Hill, Keeper Kelly Froio, Keeper Becky Richendollar for all of her editing and support, and most importantly Nkosi for all of his hard work and training skills.

An earlier version of this paper was presented at the 2011 Great Lakes Regional Gorilla Workshop (GLRGW) at the Lincoln Park Zoo in Chicago.

December 2013 Update: August 2012 saw the births of Bomassa (August 4th) and Apollo (August 31st) as the first gorilla baby births for the North Carolina Zoo in over 20 years. Nkosi continued to be our most reliable and best trainer with a continuation of further awake cardiac ultrasound exams, TB tests through training, and a new method of blood collection through his chest. The end of August 2013, a few weeks removed from celebrating the 1st birthday party for Bomassa and Apollo, we experienced a surprising turn of events. Nkosi became ill rather quickly and unexpectedly. His health went downhill drastically in a span of about one week. Due to an internal infection and the damage it had caused, Nkosi was euthanized on September 3, 2013. His legacy will be carried on by his two sons, and his training accomplishments will hopefully help inspire other keepers to work through roadblocks, set backs, and the challenge of rewarding.

TRAINING TALES

Comments: by Kim Kezer

This paper certainly demonstrates that animals CAN learn behaviors for carrots as a reward! Making a change often seems to be harder for the human than it is for the animal. With emphasis being placed on providing healthier diets for our animals, using primarily food from their diet often conflicts with a trainer's reinforcement regime. We generally think that rewards should be something novel outside of the animals diet. Unfortunately, some of our choices tend be those higher in sugar and of less nutritional value. When the option of novel food rewards is eliminated, it encourages trainers to be more creative about their reinforcements and consider taking advantage of those secondary reinforcers we may not use as often as we should.

If the animal is strongly influenced by a food reward and secondary reinforcement is less of an option, try being more creative and interesting in the way you prepare, as well as deliver the animals' reward from their diet. Remove their preferred diet items and use those only for training. Try creating a "mash" or "smoothie" with their diet. Possibly consider looking for completely novel, yet healthy, approved options. Search for veggies not already in the diet, like green beans, peas, kale, etc. that might be novel enough to peak interest and then prove rewarding also. If juice is an option, try diluting it and offering it via a syringe or spray bottle.

> **The key to success is patience and making slow transitions. Do not be discouraged if they do not respond positively at first, continue to try and eventually the animals will transition over to their new, but not so new, training rewards.**

Congratulations on your success in training and making the transition to a healthier food reward program. Sharing your Training Tale can inspire others that with a little patience and creative thinking great things can be achieved! Our jobs present us with opportunities to learn from each other and from the animals in our charge. While Nkosi's unexpected passing is distressing to your facility and to the species, his willingness to train and learn new complex behaviors during the diet and reward transition motivates us to keep an open mind about changes like these. What you learned from working with Nkosi will only benefit your training program with his recent offspring. Thank you for your submission and we look forward to hearing about Bomassa and Apollo's training in a future Training Tale... hint, hint ☺

Keepers Lend a Helping Hand:
Training Leo for Treatment of his Chronic Condition

Judy Sievert, Keeper • Stephanie Payne, Keeper • Traci Colwell, Keeper • Hugh Bailey, Lead Keeper
Woodland Park Zoo, Seattle, WA

INTRODUCTION

In 2007, western lowland gorilla managers and keepers at the Woodland Park Zoo (WPZ) were interested in forming a third group by bringing in a new male. We wanted to work with the SSP to find a male who was not over-represented genetically, and who was otherwise difficult to place in a zoo where he could form a family group. Such a male could have been solitary, an unproven breeder, socially challenged, older, in a poor living situation, or all of the above. We felt the Woodland Park Zoo would be a good fit for such a male because we have a large number of females who could be potential companions, and a relatively flexible facility with room to accommodate introductions/living space. Additionally, we have keepers who are experienced in introducing females to an older, hand-raised male who was an unproven breeder, and getting him to breed. We felt we were well-equipped to deal with the challenge and wanted to help a male who might not otherwise get the chance to be with females and have offspring.

With this in mind, the SSP recommended that we bring in Leonel (AZA SB #666). At the time he was the SSP's #1 priority for placement of a male because he was solitary and in a less than ideal situation. Leo was a good fit for the Woodland Park Zoo because he was not over-represented genetically, and was an older, hand-raised male, who never had a good opportunity to be with females. While we had planned to acquire a male with social challenges, we didn't realize that Leo also had a chronic medical condition. During his move to Seattle, we discovered that his hand clenching behavior, presumed to be only a stress indicator, was actually masking an underlying skin condition that would require constant care. This article describes how we have worked with Leo to care for his hands while integrating him into a more species-appropriate gorilla family group.

BACKGROUND

Leonel (Leo) was born on 20 February 1978 at the Gladys Porter Zoo in Brownsville Texas. Like many other gorillas born in that era, Leo was pulled as an infant for hand-rearing by his keepers. As far as we can ascertain, Leo had limited gorilla contact for the first four years of his life and as a result he became heavily imprinted on humans.

At the age of four, Leo moved to the Los Angeles Zoo and was placed in a family group. According to keepers there, Leo lacked proper gorilla social skills and the subtle communication tools that are used among gorillas living in a group. After five years in LA, Leo was moved to the St. Louis Zoo and housed in a bachelor group of young males. As Leo grew up with his peers, he did not appear to have the skills necessary to navigate becoming either a dominant male or a submissive troop member; due to his difficulty within the group he was eventually removed from the bachelor group and housed alone. Noticeable stereotypic behaviors began to present themselves. St. Louis reported very frequent bouts of regurgitation and reingestion (R&R) and was the first institution to observe Leo clenching his hands in fists. After 14 years at the St. Louis Zoo, in 2001, Leo was moved to Granby Zoo in Quebec, Canada. By this time, Leo was 23-years-old and had spent most of those years living alone. While at Granby, he was introduced to two females (Zira and Caroline) and was unfortunately only with them for a very brief amount of time, as both females passed away due to natural causes within a year of each other. Leo was once again housed alone but had visual access to an older male; having visual access to this older and mellower male seemed to work well for Leo. In 2006, Granby Zoo received a bachelor group of three young males from the Calgary Zoo, and although Leo was never fully introduced to these new males, their presence and proximity to him in the building seemed to have increased his anxiety.

In November 2008, Leo left the Granby Zoo and began his journey to Seattle. Because he was coming into the United States from Canada, Leo was required to go through a full CDC quarantine, and the Columbus Zoo offered to house him in their CDC approved quarantine facility. At the end of the quarantine period, a gorilla keeper from WPZ flew to Columbus and escorted Leo to Seattle. The hand clenching behavior observed in St. Louis and Granby was very pronounced when the WPZ keeper visited Leo in Columbus.

Photo 1: Leo's chronic dermatitis.

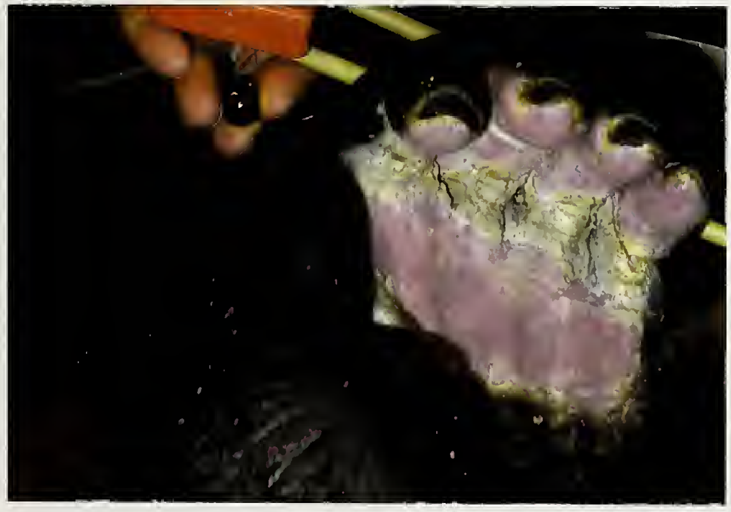


Photo 2: Leo extends his hand through bars to touch target.

During his pre-shipment exam, the Columbus Zoo vet staff was able to open his hands and examine them. The skin on the inside of his fingers and the top half of his palms was bright red and sore looking. There were lines where his finger nails had dug into the palms of his hands, and the skin at the fold where his fingers meet the palm of his hand started to tear as his fingers were pulled away from his palm. Photographs were taken and sent to the veterinary staff at WPZ; it was clear that there was a medical concern to be addressed in addition to his behavioral issues.

EVALUATION

Leo arrived in Seattle in December 2008, and during the exam for his second quarantine at WPZ, his hands were examined and biopsies were taken. It was determined that he had chronic dermatitis *(see Photo 1)* and decreased range of motion (lack of the ability to fully open his hands) due to his constant hand clenching behavior; furthermore, these two factors reinforced each other in a positive feedback loop. The long-term treatment plans to improve his hands would target both issues, and include topical treatments of his hands to address the dermatitis and physical rehabilitation to increase the range of motion of his hands.

Leo arrived at the gorilla unit on 17 March 2009. In addition to having the behavioral notes from his ADT form and information from the pre-shipment and quarantine exams, Leo gave immediate visual cues upon arrival that his hands were causing him discomfort. Aside from constantly clenching his hands, he also held his fists tightly to his chest and would continue to hold his left hand up as he walked (tripod walking). At times, he would even hold both hands to his chest and shuffle bipedally. It was apparent that his hands would need to be monitored and cared for on a daily basis.

Our first objective was to be able to see beneath his fingers, but his constant clenching made this impossible to do in a casual, non-training situation. He was also very protective of his hands, understandably, and as a result, was hesitant to present them at the cage mesh for his new, unfamiliar keepers. After he had become a bit more comfortable with us, he finally complied with the request to "touch" bamboo sticks, but would do so with clenched hands. All of Leo's training routines were established using a clicker as a bridge in conjunction with positive reinforcement.

TRAINING PART 1: HAND CLEANING AND TOPICAL TREATMENTS

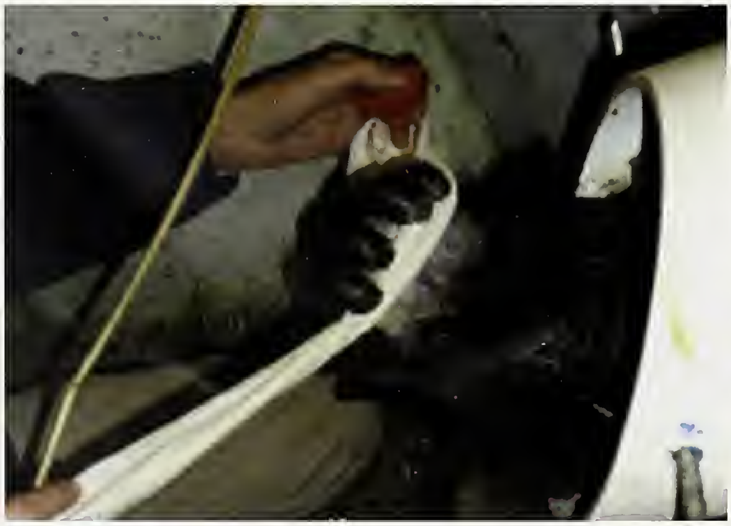
Most of our gorilla bedrooms are walled with 2"x2" mesh, but there is one area with more widely spaced vertical bars along the front, as well as a small opening that measures 8¼" x 14 ½" (used in the past for a baby introduction); this area proved to be the starting point for Leo's training. Initially, he was just asked to station at the bars and touch his clenched hands to the ends of two bamboo sticks, but within a week, Leo was able to extend his hands through the bars in order to touch his target (*see Photo 2*).

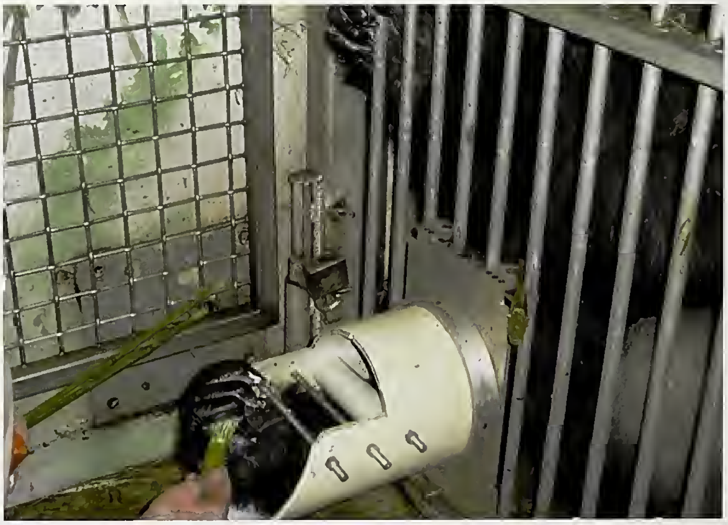
Next, a tub was secured in front of the "baby door" and filled with warm water. We placed several treats in the water (peanuts and grapes) and waited to see if Leo would extend his hands and "fish" for the treats; he did exactly that and even rested his hands in the water for a bit, seemingly getting some relief from his chronic condition. This activity also seemed to give him the confidence to extend his hands through the baby door and gave us a better idea of the modifications necessary for further training at this location.

With Leo's habitual hand clenching, it was almost impossible to see the affected areas on his palms. Our next modification was to add two horizontal rebar pieces across the opening of the baby door, creating a restricted opening with enough room to allow Leo to present each hand through the opening. Once these bars were securely in place, Leo was asked to "touch" the bamboo stick that we were holding in front of the baby door. He quickly established this behavior, alternating hands upon request. The amount of time that he was asked to extend his arm through the baby door was slowly increased until several minutes of "hold" was established. We then introduced the "open" request, which was rewarded when Leo made an effort to open his fingers in order to align them along the bamboo stick held horizontally above his finger tips. Once established, this behavior was also extended with the "hold" request; as training progressed, Leo was able to "open" and "hold" long enough for us to assess the condition of his hands in a consistent, routine way. In order to allow for better examination and reference, we began to take pictures of his hands during this process. Several shots were taken and the best picture of each hand was dated and saved as an electronic file for documentation (weekly, bi-weekly or monthly, depending on the condition of his hands). We were able to share the pictures with vet staff and consultants and keep track of improvements or set backs with the affected areas on his hands.

It quickly became apparent that further modifications were still needed, as the rebar across the baby door did not restrict Leo's range of motion enough and he really enjoyed seeing his keepers' reactions to his sudden and swift lower arm movements. Within a few weeks, keepers and a consulting plastics engineer developed an 8½" PVC pipe sleeve that could be attached to the

Photos 3-4: Leo quickly adjusts to his new, custom-made sleeve.





opening of the baby door (*see Photos 3-4*).

This modification allowed for a safer presentation of Leo's lower arms/hands, as well as giving keepers more options in the approach to various treatments. With the new pipe in place, training with Leo was accelerated. Leo quickly became habituated to gauze pads, scopettes, soft dish brushes, and strips of rags, all used to clean and dry his hands in preparation for various topical treatments. As for the topical ointments, we found that celery was the best tool for application; the base of the stalk was firm, it curved to the shape of his palm, and was easily (and affordably) replaced if he were to grab it.

Once Leo was comfortable with the sleeve and the treatments, we began to allow various new staff to sit and watch, habituating him to new people in the training area. This process allowed not only for the vet staff to come and observe, but specialists as well. In addition to the human company, Leo quickly became comfortable participating in training within the presence of his two female gorilla companions, Akenji and Nadiri. This progression was proof to us that he was comfortable with the set up and trusted and understood our intentions.

In January of 2011, the Animal Health Department introduced the idea of class IV cold laser treatment as a possible treatment of Leo's skin condition. Our earlier training to habituate Leo to various tools, noises and visitors really benefitted his introduction to this type of therapy. In order to achieve the optimal amount of exposure, Leo had to "hold" his hand through the sleeve while we held the probe over his affected areas for a cumulative 10 minutes. This took a lot of patience on his part, as well as everyone else's involved, but after several sessions, Leo became accepting of the warming light laser probe, the noisy machine that accompanied it, the various vet techs whom assisted, and the time it took to complete a session (between 25-45 minutes in order to complete a full dose of a 10 minute exposure of 6010 joules @ 10 watts). Unfortunately, we did not see the results we were hoping for and the Animal Health Department decided to discontinue the laser treatments at the end of the trial period (six weeks).

TRAINING PART 2: PHYSICAL REHABILITATION

We think the dermatitis persists even with all of the on-going and varied topical treatments due to his clenched fists. His hands have been clenched for so long that the tendons and skin have become foreshortened, restricting extension of his fingers, and the skin on the palm of his hands is usually macerated. As a result, this skin tears easily along the crease where his fingers meet his palm (the palmar digital crease) when his clenched hands are opened, and he has a few chronic ulcers along this crease on each hand.

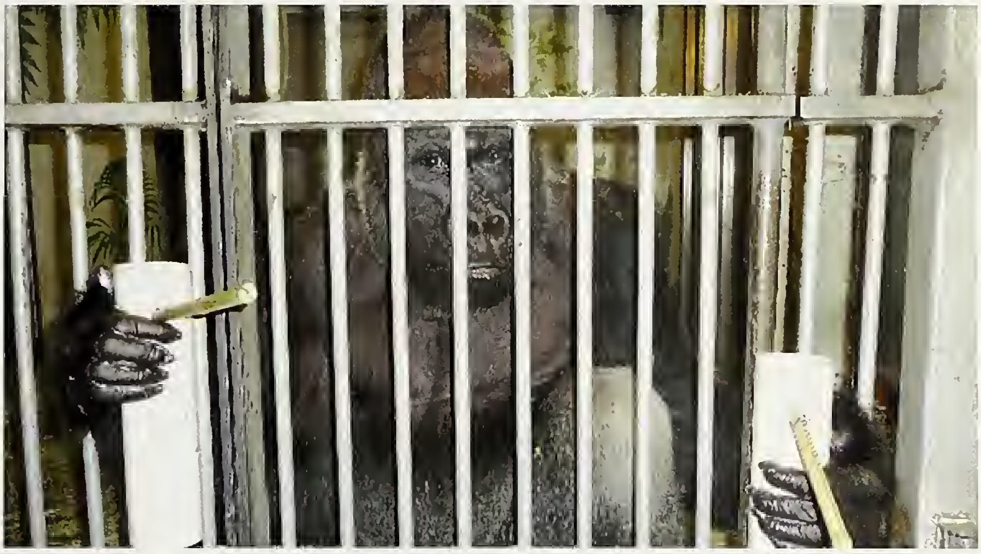


Photo 5: Leo participating in physical rehabilitation.

Since he was unable to open his hands fully, we felt it necessary to start physical rehabilitation in order to improve his range of motion. We hoped that if we could get him to relax and open his hands we would start to see improvement of the affected skin on his palms and fingers. We devised several ways to have him extend his fingers away from his palms further than he typically did, and again, Leo proved to be a willing participant.

We first started by asking him to stick the four fingers of each hand through 2" square wire mesh and rest them while he was fed. Even this simple task was difficult for him at first; his fingers would shake as though they were weak while he stretched them open and placed them through the mesh. When this behavior finally became easy for him we attached 1", 1¼", and 1½" diameter pieces of bamboo horizontally to the keeper side of the wire mesh at different heights. He was then trained to place his four finger tips on the bamboo and eventually asked to hang them out and over the bamboo. He was easily able to do this with his right hand but had more difficulty with his left hand, and it took several weeks before he was able to actually hang his left fingertips over the 1½" diameter bamboo. Then, Leo was trained to stick his hands out of a wall of ¾" vertical bars spaced 2¼" apart and hold onto PVC pipes, ranging from 2" to 4 ½" (*See Photo 5*). We started with smaller pipes and slowly increased to having him hold larger diameter pieces as his range of motion increased. Lastly, he was asked to open and shut his hand several times by lining up a bamboo stick against the knuckles of his fingers.

CONCLUSION

Currently, Leo's hands are cleaned twice a day with a topical ointment of Bag Balm® and silver sulfadiazine (a 50:50 ratio). He also continues to participate in a 10-minute physical rehabilitation session after each of his twice daily hand treatments. While the physical rehab has improved the range of motion in his fingers, he still continually clenches his hands. The condition of his skin continues to vary, from hyperkeratosis to pink (much like diaper rash). This variation may be dependent upon many factors that are quite difficult to identify as specific or isolated causes; some of these may be weather patterns (moist vs. dry air), stress within his social group, or cyclical cellular variations.

While Leo's hand condition is an ongoing problem, he is no longer by himself and has overcome some of the social limitations he faced previously. He is very comfortable in his current social group with two females; he engages in close physical play, settles altercations, and shows sexual interest in his females but, to date, no mating has been observed.

Leo's intelligence and flexibility has been a huge asset to our training program. Because of his cooperation, we are now able to assess his chronic dermatitis condition and treat it in various, non-invasive or low-stress ways. His hands may always retain some level of dermatitis and limited range of motion, but with our training program established, we are able to monitor, reassess and redirect his therapy as necessary.

Photos courtesy of Judy Sievert

Training a Gorilla for Cardiac Ultrasound: the Challenges and the Reward

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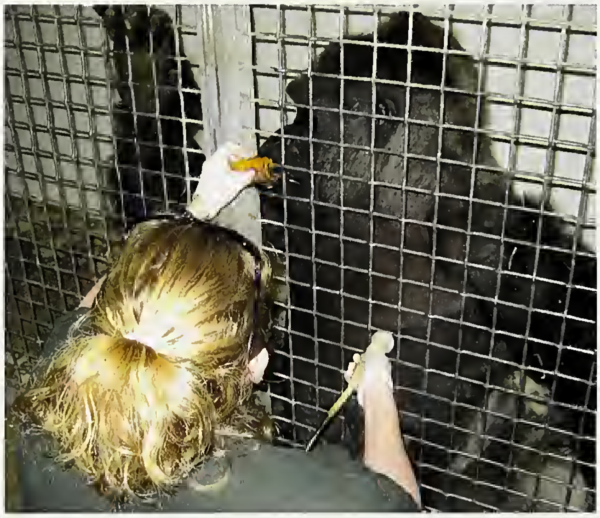
Fort Worth Zoo • Fort Worth, Texas

Heart disease is a primary cause of death of gorillas (*Gorilla gorilla*) in zoos. To better understand cardiovascular health and disease in great apes, the Great Ape Heart Project (GAHP), led by Zoo Atlanta, was established to create a comprehensive database of cardiac information from individual apes housed in Association of Zoos and Aquariums (AZA) zoos. Information in the database can then be studied to determine risk factors for cardiac disease and improve the health of apes in zoos.

The Fort Worth Zoo in Fort Worth, Texas, houses five (2.3) western lowland gorillas ranging in age from 21 to 41. Ramses is a 41-year-old male gorilla. Because male gorillas are particularly at risk for heart disease, we agreed that it would be beneficial for us to have the capacity to monitor his heart condition on a regular basis. We also wanted to partner with a professional cardiac ultrasound technician who could use their expertise and high-quality equipment to perform diagnostic exams on our gorillas and acquire images to contribute to the GAHP database. We learned about other institutions that were successful with gorilla cardiac ultrasound training and watched a video created by Disney's Animal Kingdom that demonstrated the procedure. However, we knew it would not be a simple endeavor and would require time, patience, teamwork and support from our management. We began with Ramses' training, but our ultimate goal was to train all five of the zoo's gorillas to hold for cardiac ultrasounds. This paper outlines some of the challenges we encountered while training Ramses, and how we overcame them.


Ramses holding his chest against the mesh with his arm down during a cardiac ultrasound training session with Kate *(photo: J. Elston)*

Ramses is housed with a 40-year-old female, Amani. Their night holding connects to their exhibit via two chutes on either side of a keeper hallway. Routine training took place during the morning (approximately 0900 hours) before the gorillas were shifted on exhibit, and each gorilla was trained in separate chutes across from one another. Following our training plan and using positive reinforcement, I began training Ramses to present his chest against the mesh using the verbal cue "chest". Reinforcement varied, and included items from his diet such as grapes, dried fruit, fruit juice and cooked sweet potato. As Ramses accomplished each step, he received a "jackpot" of peanut butter, jelly or honey. Once Ramses was presenting his chest and letting me touch him with a mock ultrasound wand, I needed to fine-tune his position. Our goal was to have him present his chest flush with the mesh so we could touch him all around his nipple area with the wand, without having to put the wand very far through the mesh. This would help avoid any potential damage to the real ultrasound equipment. I began with him holding the mesh with his hands above and adjacent to his head. My first challenge was with him in this position, it was difficult for him to get the area to the left of his nipple flush with the mesh. However, as I continued to ask him to press his chest up closer to mesh, he began dropping his left arm down to his side and turning his left shoulder into the mesh. In this position, he could get the area around his nipple more flush with the mesh. I captured this new position and shaped it with the verbal "chest" cue, and this is the current position he holds when we do the ultrasound training.

After training for chest presentation, the next challenge was incorporating additional staff into the sessions. Initially, we decided that one of the zoo's veterinarians should operate the zoo's ultrasound machine until we could involve a professional cardiac technician. During these training sessions I gave Ramses the cue "chest" and the vet held the mock ultrasound wand to his chest. We quickly decided this method was not going to work, because the vet would need to look away from Ramses and the wand in order to view the ultrasound screen. We felt the person holding the wand needed to monitor Ramses' behavior to ensure equipment was not grabbed or broken by him. So we agreed the best option was to have me hold the wand while the vet (and subsequent cardiac technician) viewed the monitor and directed me how to position it on Ramses' chest.

The next challenge we faced was being able to maintain consistent training sessions. We were unable to arrange enough sessions during the week because of the irregularity of the vet's schedule, and we knew we needed to have more sessions in order to make progress. However, we wanted to include someone who was not one of Ramses' keepers in the training, to help him adjust to an "outside" person being present, so that we could later involve an ultrasound technician in his sessions. So, our curator of conservation and behavior, Jenny, joined the training to play the role of the technician, an adjustment that provided the opportunity to train up to four times a week.

Now the challenge was getting Ramses comfortable training with Jenny present. Ramses tends to be standoffish around new people, and will run up and down his chute and display. So we worked on building trust between Ramses and Jenny. This was accomplished by having Jenny wear a keeper uniform shirt (something familiar he could visually identify) and giving him opportunities to see her from his night holding before he shifted into the chute for training. We also started each session with Jenny positioned at the entrance to the hallway and when he approached me to train she would slowly move closer until she was next to me. At first Ramses would leave the session and display, but when he remained Jenny would offer him grapes to reinforce his staying. After about a month, Ramses was doing well with Jenny present. However, he often still displayed before focusing on his session, and would occasionally refuse to train if Jenny was sitting next to me at the beginning of the session. We decided that instead of trying to verbally coax him over for a session after he displayed or backed away, we would give him a brief timeout and turn to the opposite chute and focus on training Amani. We verbally praised Amani during her sessions and this seemed to make Ramses more interested in training with us. Approximately five weeks after Jenny joined the sessions, Ramses became more consistent with his training, decreased his display time, and joined the sessions even with Jenny sitting next to me at the beginning.

View of Ramses' heart on the ultrasound machine during a training session *(photo: J.Elston)*

Now that the team was in place, our next step was to introduce transducer gel to Ramses, because gel is needed on the ultrasound wand for it to function. I started by putting a little gel on my finger and touching him with it or letting him touch it with his finger. I then began to add gel to the mock wand, which created our next challenge. Ramses was presenting his chest very well for the mock wand alone, but he would leave the session after I applied gel to the wand. We used a combination of verbal coaxing or a timeout to encourage him to rejoin his session and accept the gel on the wand, but often we had to wipe the gel from the wand so that he would present his chest. After about a month, we decided I should no longer wipe the gel off the wand and reward him for holding his chest for the wand only. I began to reinforce him for holding his chest for the wand only when it had gel on it, so that he would learn that the gel is part of training with the wand. Ramses adjusted to this change very quickly.

Our next goal was for Ramses to hold his chest in place for a least one minute, allowing adequate time for a technician to collect images to review for diagnostics. I increased his holding time in 10-second increments so I ended the session before he broke his position. I gave him continuous reinforcement via food and verbal praise, as well as a verbal "hold" cue. Within a week Ramses was holding consistently for up to 15 seconds, and after about a month Ramses was holding for around 30 seconds. Approximately four months after Jenny joined the training sessions Ramses held for one minute! After this breakthrough, Ramses began regularly holding for at least one minute and doing so for multiple times during a session.

With that accomplishment, we were ready to work with the zoo's ultrasound machine. Our director of veterinary services was supportive of our training and involvement in the GAHP, however, because ultrasound machines are expensive, we had to demonstrate that we were ready to use the machine. We discussed having one of our vets watch a training session to see how well Ramses was doing, but we knew that Ramses would react to having a vet present and might not train well. We determined that we would videotape a session and meet with our vet staff and mammal curators to view the video and discuss our training. With full management support, we were given permission to use the zoo's ultrasound machine during our training sessions for the purpose of determining the locations on his chest where we could see his heart. It was agreed that once we were able to locate his heart, we would ask a technician to attend training sessions with Ramses.

To prepare Ramses for the addition of the ultrasound machine, we began incorporating a laptop computer into our sessions to simulate the machine, and he adjusted well to the addition of the equipment. We then felt confident and ready to try the ultrasound machine. Just a little more than six months from when we began working together with Ramses, we saw his heart!

Over the next few weeks we continued to use the ultrasound machine and captured still images to share with our vet staff. Then it was time to bring in a cardiac ultrasound technician. Luckily, our director of veterinary services had connected with a technician who was willing to volunteer to work with us once a week. On her first visit to meet Ramses, he did some displaying but he settled down rather quickly and allowed me to do a brief training session with him. The following week Ramses held for his first diagnostic exam, and the technician was able to record some images.

In this paper we focused on our training with Ramses; however we have also trained our other four gorillas to hold for cardiac ultrasounds, and have seen the apical four chamber, long axis and short axis views on each of them. We have been able to capture many images, and the technicians can use the information to measure health parameters such as the ejection fraction (percentage of blood pumped from a filled ventricle during a heartbeat) and perform diagnostic exams. We had similar challenges with each gorilla (e.g., chest positioning, unfamiliar person's involvement, transducer gel, wand positioning, etc.), and each challenge had its own unique solution. Time, patience and support from our team were instrumental to our success, and our reward is the benefit this training will have on the health of not only our gorillas, but gorillas in other zoos as well.

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Advancing Gorilla Care Through Positive Reinforcement Training: Two Case Studies

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Nicole Meese MacCorkle, Primate Keepers
Suzan Murray, Chief Veterinarian

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Washington, DC

Mandara with two-month-old Kibibi.
Photo by Mehgan Murphy, Smithsonian's National Zoo

INTRODUCTION

Positive reinforcement training has become embedded into the husbandry practices of managing animals in zoos, especially in regards to great apes. Here we describe two examples of simple training with western lowland gorillas (*Gorilla gorilla gorilla*) that, while not anticipated at the time, allowed us to easily transition to more complex behaviors that subsequently increased our knowledge of gorilla health issues. Without the collaborative efforts between keeper staff, veterinarians, and nutritional scientists at the Smithsonian's National Zoo, none of this would have been possible. The following case studies illustrate how keepers achieved valuable results that can extend beyond the individual gorilla to benefit the entire species.

KWAME AND KOJO

The characteristics of and treatment for cardiac disease can vary greatly between species. It is described that fibrosing cardiomyopathy (the replacement of heart muscle by fibrous tissue) is the leading cause of death in captive western lowland gorillas. More than 40% of captive gorilla deaths in American Zoological Association (AZA) facilities are due to cardiovascular disease, with the majority of these occurring in males. In an effort to further investigate the causes of this disease, keepers and veterinarians at the National Zoo have collaborated to utilize technologies new to non-human primate medicine to learn more about both normal and abnormal features of gorilla heart disease.

During routine physical examinations in February and March of 2012, 2.0 western lowland gorillas (Kojo and Kwame, ages 10 and 12 respectively at the time) at the National Zoo were the first two individuals of their species to receive Implantable Loop Recorder (ILR) devices to monitor cardiac function. An ILR is a small device that measures and records electrical activity in the heart without wires and leads. The ILRs were placed subcutaneously between the shoulder blades of each gorilla. This location was determined to be suitable for the implants to record cardiac data and to be easily accessible to keepers during training.

It is necessary for the data collected in the ILRs to be downloaded from the devices in order to be evaluated. This is done by holding a monitor adjacent to the implant and "interrogating" it. As our gorillas were already trained to present their backs to keepers for examination, it was just a matter of preparing them for the interrogation process. The biggest hurdle was acclimating the two males to the monitors and their accompanying array of beeps and lights. Once that was accomplished, they both quickly progressed to allowing keepers to hold the monitors against the devices in their backs for the length of time necessary to transfer data. On average, it takes only 30-45 seconds to download the information to the monitor, but since that can seem like a lifetime to a gorilla patiently waiting to receive a food reward, we decided to introduce a second trainer and utilize continuous reinforcement during the interrogation sessions. The data can also be affected by even slight movements from the animals during downloads, so this also helps to reduce possible fidgeting from the gorillas. The cardiac information is downloaded from the ILRs about once a week by keepers, and then sent to and reviewed by a human cardiologist as well as veterinary staff.

For the safety of both gorillas and veterinarians, typical assessments of cardiac function are conducted while animals are under general anesthesia. Due to the possible side effects of anesthetic drugs on heart values and function, any training that can lead to cardiac evaluation while a gorilla is awake is extremely valuable. Additionally, only a snapshot of an individual's health is obtainable while they are under anesthesia, but ILR training

Downloading cardiac data from Kwame's ILR.
Photo by Office of Public Affairs, Smithsonian's National Zoo

has allowed us to collect continuous cardiac data such as heart rate, heart rhythm, heart rate variability and activity budgets from two blackback gorillas.

Kojo and Kwame were chosen to be the first recipients of these devices for several reasons. First, at the National Zoo, we already had an established positive reinforcement training program which all of our gorillas were involved in. Second, in June 2006, we unfortunately lost two silverbacks, only two days apart from one another, both to heart disease. As a result of these tragedies, our veterinary and keeper staff became even more passionate about and committed to contributing to the knowledge base for understanding the causes of and treatment for gorilla cardiac disease.

We hope that the data collected from the ILRs can provide further insight into the causes of gorilla cardiac disease, assist with earlier diagnosis, and help evaluate the efficacy of medical therapies in the captive population. Ideally, additional longitudinal studies can be conducted with other individuals, even if to only gather more baseline gorilla cardiac data.

MANDARA

Producing milk is a defining characteristic of being a mammal. Mammal infants can digest little else when they are born and are dependent upon the vitamins, sugar, fat, minerals, and growth factors that are passed to them through their mother's milk. It is important to continue learning about the composition of milk not only to understand how it changes over time, but also to develop improved formulas needed for hand-rearing infants.

Historically, milk sample collection methods for mammals have varied. While some hoofstock animals (e.g., antelope, rhinos, etc.) can be restrained in a squeeze chute, primates need to be anesthetized to ensure the safety of the animal and the person collecting the sample. Though both are effective techniques, physical restraint can be stressful and may cause them to resist the procedure, and anesthesia can be risky at all times -- it is not a practice that can be performed routinely or over a long period. Food distractions have the potential to maintain some animals' attention long enough for a milk sample to be collected, but this only provides a small window of time in which the process will be tolerated by the animal since the behavior is untrained. Though any milk samples collected are invaluable to learning more about milk, restraining, anesthesia, and stress may all affect its composition.

The Smithsonian's National Zoo is a leader in nutritional science studies. The zoo has a large milk repository with scientists studying milk composition from over 150 different species. In 2008, the primate team was asked if our expectant western lowland gorilla, Mandara (then 25-years-old), could be trained to provide consistent milk samples for study. Mandara, pregnant with her sixth offspring, made the perfect candidate to pioneer this trained milk sample technique because she allows for close inspection of herself and her infant through our normal husbandry training process. Mandara is a proven, competent mother, successfully rearing all of her infants in a zoo setting without keeper intervention or neonatal exams. All gorillas at the zoo are trained for basic husbandry behaviors, allowing for body parts to be inspected for injury or issue, including presenting their chest.

Positive reinforcement training for milk collection started as Mandara reached the end of her pregnancy. She was already trained to present her chest and allow for manipulation and expression of her mammary glands. The behavior was initially trained by one keeper with the help of back up trainers to sustain the weekly collection of samples. Milk samples (varying from 1 to 10 mls) have been obtained since the birth of her infant (January 2009). Once collected they are sent to the National Zoo's nutrition team for labeling, storing, and analysis.

Several key successes have been accomplished by training the milk collection behavior. First, the safety of both the animal and the trainer has been increased by eliminating the need for anesthesia or restraint. Second, the milk samples obtained are the closest representation of what the infant was actually receiving from the mother (i.e., free of anesthesia, hormonal, and stress effects). Third, perhaps the most important for keepers, the trained behavior has gone from a research collection method to a form of enrichment. Lastly, Mandara's milk samples have provided sustainable, fine-grade longitudinal data which makes her the most represented mammalian female in terms of milk composition. The positive reinforcement training techniques and protocols used with Mandara can now be used as a tool for other zoos to further the advancement of milk studies in great apes.

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CONCLUSION

While the two areas of study that have been advanced through positive reinforcement training are quite different, the similarities lie in their final outcomes. Both the fields of cardiac health and nutrition have been broadened through the data collected by keepers through basic husbandry training. We hope the information that has been collected through this training will enhance the body of knowledge for gorilla health and medicine.

The authors would like to thank Medtronic, Inc. for donating the Implantable Loop Recorders and associated equipment. We also thank the veterinary team, nutrition team and primate keeper staff at Smithsonian's National Zoo for their vital support and encouragement to utilize training to advance gorilla health and husbandry.

The Heartbeat Behind the Chestbeat:

Training Gorillas for Stress-free Monitoring of Vital Statistics

Jodi Carrigan – Primate Keeper • Zoo Atlanta • Atlanta, GA

With 21 gorillas and two pending births, Zoo Atlanta is home to the largest collection of gorillas in North America. The Zoo also houses one of the nation's largest geriatric collections, with three gorillas over the age of 51, including the oldest gorilla male in the world. While we are proud to feature such a large group of gorillas, there are obstacles to caring for such a large collection, not to mention the challenges we encounter when caring for aging gorillas.

In order to effectively manage such a large collection of gorillas and be prepared for issues or problems we may at any time encounter, we work proactively to train our animals for preventative purposes.

HAND-INJECTIONS AND VOLUNTARY PRENATAL ULTRASOUNDS

In the early stages of our training program, we focused on basic husbandry behaviors such as shifting, body part presentation, stationing and most importantly injections. These basics are essential when working with such a large collection. Each year we hand-inject

Jodi Carrigan and voluntary cardiac sonographer Diana Ketchum from Children's Healthcare of Atlanta obtaining awake ultrasound.

Obtaining voluntary blood pressure on Ozzie

Vet tech and keeper obtaining a voluntary X-ray

flu shots to all of our gorillas, as well as hand-inject for physicals. The hand-inject method is particularly helpful to our routines, as the large size of our collection often requires staff to perform four physicals in two days.

In some cases, animals may even watch another gorilla being anesthetized yet remarkably they'll still allow themselves to be hand-injected for their turn. No matter how many times I see this, I'm always amazed and impressed that they allow this to happen.

Voluntary prenatal ultrasounds help us monitor fetal growth and pregnancy progression. This is very important when we do not know the date of conception; using ultrasound can help us narrow down the birth window.

CARDIAC ULTRASOUNDS

Heart disease is the leading cause of death in all apes, particularly gorillas. Around 41 percent of captive gorilla deaths are the result of heart-related illness, yet no one really knows the underlying causes (McManamon 2012). Zoo Atlanta has made several standout achievements in our efforts to aid in early diagnosis of cardiac disease and to monitor individuals who are already showing signs of heart disease.

We know that heart rate variability is one indicator of heart disease in humans, and therefore obtaining voluntary heart rates helps monitor the progression of the disease. As a result, having a basis of what a "normal" heart rate for an individual is can be very useful. For example, one of our males, Taz, has a resting heart rate of 72 beats per minute. When he is agitated, his rate is in the 90s, and when he has been very active it is in the 80s. If we know he's calm and reading in the 90s, that's cause for concern, prompting our vet staff to keep a closer eye on him and most likely follow up with an ultrasound.

With voluntary cardiac ultrasounds, we can physically look at the heart without the risks or complications of anesthesia. Heart wall thickness is the first thing that changes when gorillas develop heart disease (Murphy 2011). Anesthetic drugs can potentially slow or increase the animal's heart images, making training for awake ultrasounds even more important. With voluntary cardiac ultrasounds, we are also able to look at blood flow and valve contraction.

VOLUNTARY BLOOD PRESSURE READINGS

In 2009, Ozzie (DOB 1961) became the first gorilla to allow awake blood pressure readings. Experts believe that high blood pressure is a contributing factor to heart disease. Anesthetic drugs affect blood pressure, and there is a high level of concern anytime an older animal is anesthetized. With this training, we've been able to monitor Ozzie's blood pressure and heart rate without anesthesia, which is even more valuable when he falls ill.

Voluntary blood pressure readings, ultrasounds and heart rates allow our vet staff to more accurately monitor the health of our animals and establish treatments accordingly.

VOLUNTARY RADIOGRAPHS

The benefits of having such an accomplished training program are that animals are used to being trained and the staff is comfortable training, allowing us to prepare for unexpected situations that require training a new behavior in a short period of time. As an example, one of our bachelor gorillas returned from his exhibit one day not bearing any weight on his arm. Vet staff contemplated immobilizing him to examine his arm or just giving him pain medication. With a training program already established, we were able to add to this and in just one day train him for voluntary x-rays.

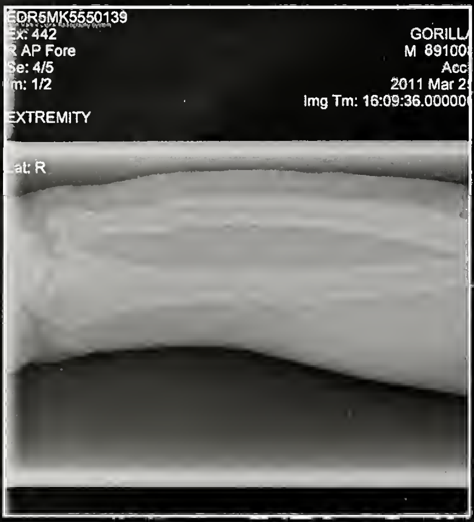
Gorillas have an especially high pain tolerance, so we were uncertain if it was a sprain, arthritis or a broken bone. The x-ray confirmed it was a break; his ulna was completely broken in half. Voluntary radiographs allow us to monitor conditions such as broken bones and arthritis without sedation, and they help us track the progression of healing. With training, we are able to use technologies such as radiographs to evaluate the health of an animal, without sedation.

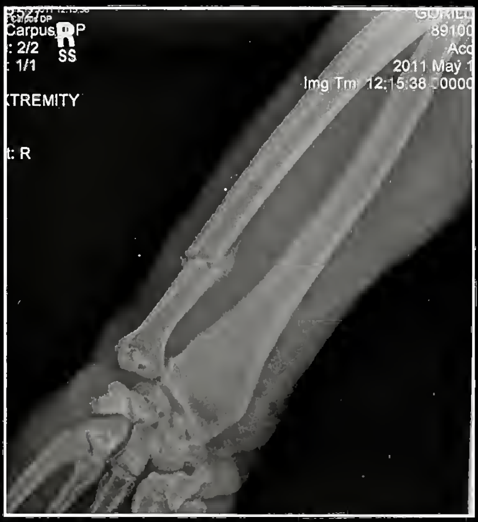
When it comes to finding time for training, staffing is the most common concern and challenge at many institutions, and Zoo Atlanta is no exception. As a result of vacation time, sick leave or coverage in

PHOTOS OPPOSITE PAGE:
(Top left) Assigned vet tech Kimberly McDermid administering flu shot to Charlie.

(Bottom left) Jodi Carrigan obtaining voluntary heart rate on gorilla Taz.

(Right) Jodi Carrigan and gorilla-assigned vet tech, Kimberly McDermid, training for prenatal ultrasound.





(Left) First X-ray taken the day after injury.

(Middle) Tenth X-ray taken almost two months after injury occurred allows us to monitor progression of healing.

(Right) Image of blood flow in a gorilla heart.

other areas, we may have six months out of the year during which there are only two keepers working in gorillas on any given day. Two days a week, we have only two keepers working, and all of our shifts offset each other. To add yet another obstacle, we're only able to train animals in the early morning or evening when they're not on exhibit.

As a solution, we manage time carefully and we utilize everyone, especially our interns and vet technicians to maximize the time and effectiveness of our training efforts. Each tech is assigned to a designated area in the Zoo to help us accomplish training goals for the year and anyone who works in animal care knows that there's a huge benefit to having animals familiar with vet staff.

Training requires an initial investment, but it ultimately reduces keepers' time that they would spend in stressful and sometimes risky procedures. For example, we can get information on a fracture in 30 minutes via voluntary radiograph, rather than during a three-plus hour immobilization. We are also fortunate enough to have a training panel built into one of our exhibits, where we can work on training when we have free time during the day. This has also resulted in on-exhibit training demonstrations, which create a more enriching and educational experience for guests.

Zoo Atlanta has worked to establish an extensive training program with our gorilla collection. We have had our challenges and will no doubt continue to have challenges as we expand our program further, but we are also proof that it can be done. With an investment in training now, we can ensure a long healthy future for the current generation as well as generations to come.

REFERENCES

McManamon R. and L.J. Lowenstine. 2012. Cardiovascular Disease in Great Apes. In *Fowler's Zoo and Wild Animal Medicine Current Therapy*, Vol. 7:408-415. Editors: R. Eric Miller and M. E. Fowler. Elsevier Saunders

Murphy, H.M., Dennis, P., Devlin, W., Meehan, T., and I. Kutinsky. 2011. Echocardiographic Parameters of Captive Western Lowland Gorillas (*Gorilla gorilla gorilla*). *Journal of Zoo and Wildlife Medicine.* December 2011, 42(4):572-579.

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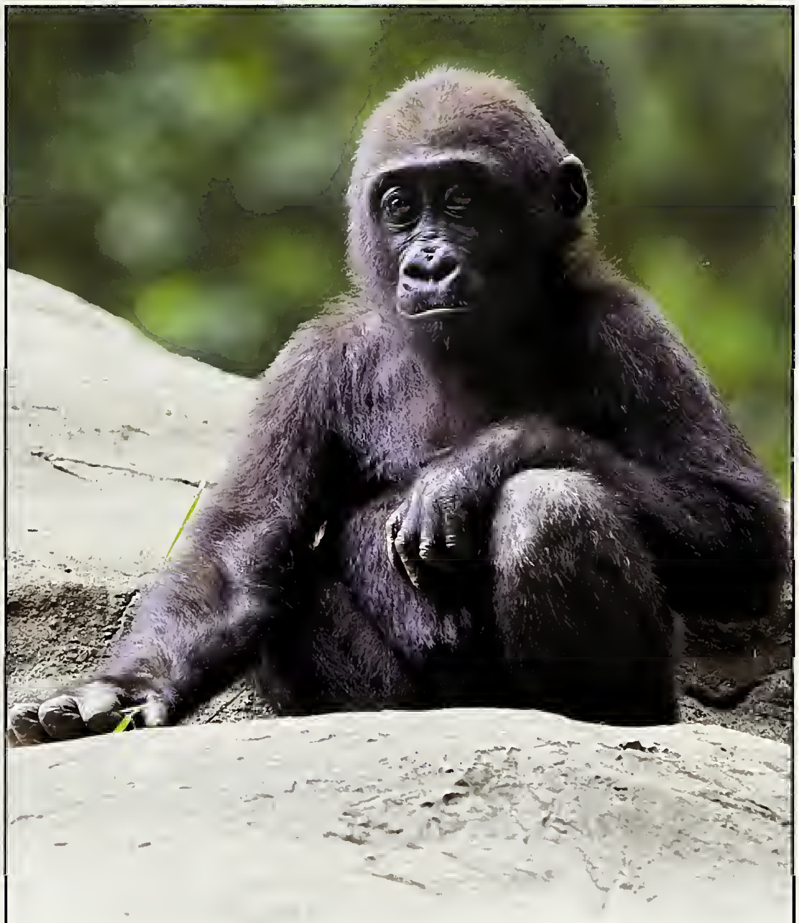

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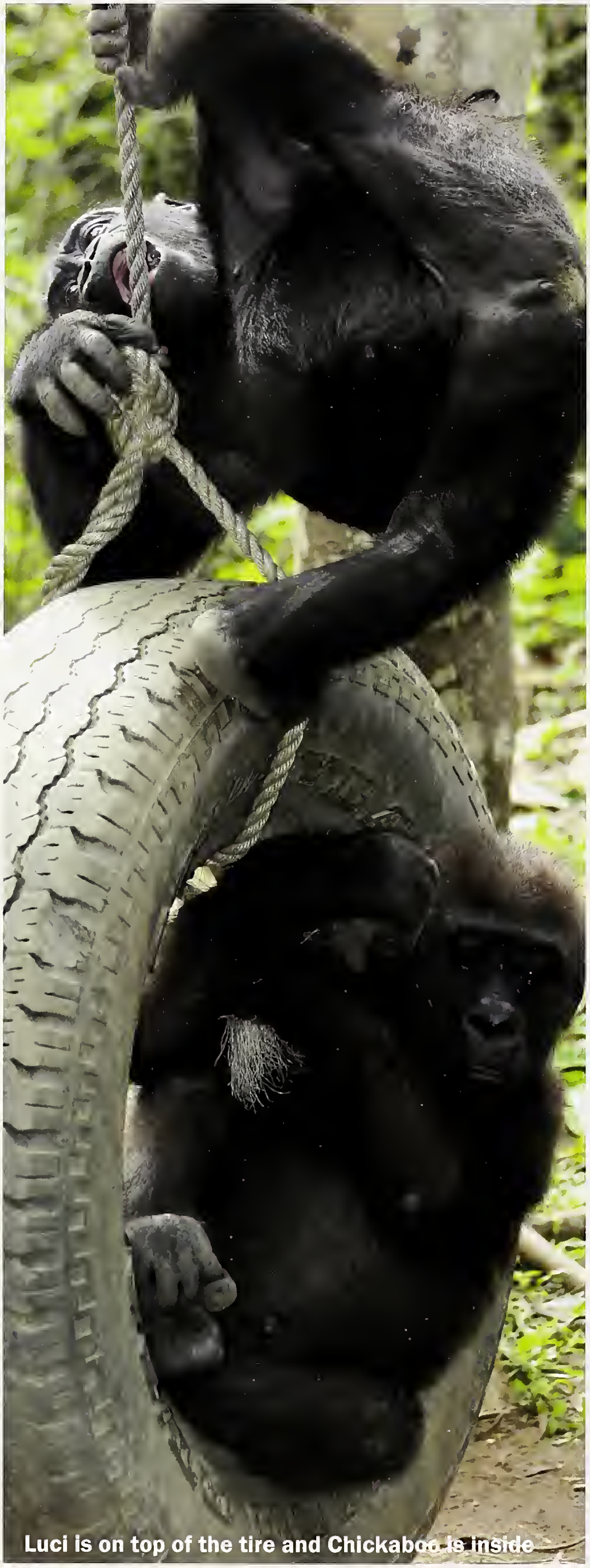
the ***AKF*** needs your photos as potential cover photos and special feature photos throughout the issue. All photos need to be high resolution, 2625 x 3375 pixels or greater, and 300 dpi or greater in resolution. All photographers will need to submit a photo release form that can be found at aazk.org/animal-keepers-forum/aazk-photo-model-release-form. Photos that clearly depict facility logos and behind-the-scenes shots will need permission of the facility to be used.

Subjects for the photos should revolve around animal husbandry, conservation, education/interpretation, professional development, significant achievements in the industry (births, exhibits, staff, etc.), and can also include some of the more humorous or unique situations that we all come across each day in our occupations. Captions for each photo should also be submitted.

Photo by Donna Morrow


Luci is on top of the tire and Chickaboo is inside

Helping Cameroon's Western Lowland Gorillas

(Gorilla gorilla gorilla)

Susan Eberth, Keeper II, Toronto Zoo
Toronto, Ontario, Canada

INTRODUCTION

Within Africa there is a governing body for primate sanctuaries called Pan African Sanctuary Alliance (PASA). PASA currently has 22 member sanctuaries across the continent, five of which care for gorillas confiscated from the illegal wildlife and bushmeat trades. Ape Action Africa (AAA), formerly called Cameroon Wildlife Aid Fund, is one of the PASA sanctuaries located in the country of Cameroon. The project is situated on approximately 10 square kilometers of forest, about an hour's drive from Yaounde, the capital of Cameroon. Established in 1996, AAA has provided sanctuary for wild orphans of the illegal bushmeat and pet trades for over 16 years. With hundreds of primates in their care, AAA is now one of the largest conservation projects within Africa and currently is home to 21 western lowland gorillas. The western lowland gorilla is considered to be critically endangered due to the severe decline in populations over the last 25 years. A decline which results from the loss of habitat as logging concessions appear and with those concessions come roads into the forest which never existed, roads which make easy pathways for the bushmeat hunters. It has been reported that up to a metric ton of bushmeat is unloaded from rail cars arriving in the city of Yaounde daily. (Stanford 2012)

OVERVIEW

A majority of the gorillas residing at the AAA project are orphans of the bushmeat trade; only three do not fall into this category. Bushmeat is from the wild animals living in the forest or bush which have been hunted for consumption. Unfortunately, the infant clinging on to its mother during an attack not only witnesses the entire ordeal but typically survives with serious physical and psychological trauma. This is the case with most of AAA's rescued gorillas. The intensive care required for each one can take years in some instances. It all depends on the condition at the time of arrival. The information about the three gorillas which aren't bushmeat orphans is also important. The first, Yeba, meaning "universe" in a local Cameroon dialect, came to the project after being discovered next to his deceased mother's body. His story is quite tragic itself as he was almost left to die for fear of an Ebola outbreak. Found in the Dja Reserve with deceased chimpanzees in the same vicinity, the research group left the area immediately to avoid any possible contamination, however, all were quite aware as well of the live infant gorilla being left behind. Luckily for Yeba, the research team returned three days later in full hazmat gear to find him still alive. They collected the mother's body for testing and removed the infant from the scene. The AAA project was called upon to care for the infant who was placed immediately in isolated quarantine with a Cameroonian keeper. After a few months the test results were available regarding the cause of the mother's death which was determined as anthrax poisoning. The second, Eto, named after a Cameroon football player, is the first gorilla born into a sanctuary group of orphaned gorillas and entirely mother-reared and group-raised. Although this was an unplanned pregnancy, the event resulted in great success for the group. The third, Bani, was rescued from a village just a few years ago. When the project got the call for help, she was reported as an orangutan. Upon arrival, she was tied up with a man holding her down and beating her. She had injuries to her face but nothing serious; she healed quickly and was estimated at six years of age. The report was she had been dragged out of the forest. No one knew why she was on her own or where her remaining group went as there weren't any signs of hunting.

Initially my thought was to introduce a few of the individual gorillas personally as each of their rescues is worth sharing, but with one situation in particular still ongoing, this article will focus primarily on him.

THE RESCUE

Early in 2006, AAA was called by the Ministry of Environment and Forestry (MINEF) to rescue a young male gorilla found tied by rope in a village. The report was he had been there for four days and was being teased by children and village dogs. Upon arrival the villagers escorted the AAA vet into one of their houses where the gorilla was tied to a wooden post. It was obvious the gorilla was in critical condition with gunshot wounds to his left arm and right side of his head. After further examination it was determined part of his right ear was missing and he was suffering from multiple shot gun pellet wounds throughout his left forearm. The gorilla was also estimated at approximately a year of age. The project staff suspected, as with most of the rescues, these wounds were a result of the infant's mother being shot while he was still clinging to her, therefore receiving direct attack as well. The gorilla was so traumatized both physically and mentally they did not expect him to survive. While the wounds were cleaned twice a day, it was clear they were causing his condition to deteriorate rapidly. A picture of exactly what was going on was crucial. The project staff searched for a hospital with a radiograph which is nearly impossible to find in Cameroon. Additionally, the hospitals aren't keen to help animals when they have so many humans in need, making the task extra difficult. Eventually they were able to locate the use of a machine and the x-rays indicated the shot gun pellets had gone through the left wrist joint. The concern of infection developing and completely destroying the joint confirmed surgery was going to be required. Additionally, the shot gun pellets had to be removed immediately.

SURGERY

At this point, the project enlisted the help of Dr. Sheri Speede. Sheri is the director of a chimpanzee sanctuary in the north of Cameroon and often lends her veterinary expertise. With her help and the AAA vet team, the young gorilla received his first surgery on the kitchen table at the AAA director's home in Yaounde. The project staff quickly improvised and sterilized the room for the procedure, complete with surgical clothes, overhead lighting and essential surgical equipment. With the patient completely anesthetized, the procedure began. In total, seven pellets were removed from beneath the skin on his left wrist and forearm leaving gaping holes behind. It was a grueling process in the Cameroon heat with the added temperature of the head lamps but the vet team prevailed. His head and ear injuries were also cleaned and sutured. With the little gorilla's surgery complete and bandages in place, he was on the way to recovery. As the days progressed, more trust was established, however it took approximately a month before he would allow human touch to occur. Eventually, just that happened though and the AAA manager knew then he was going to be okay. It wasn't until this moment the little gorilla received his name, Shufai, which means "one with courage" in a local Cameroon dialect.

Photo courtesy of Vanessa Creagh Phelan

THE MEETING

Introducing Shufai to his new family was on the horizon but first he needed to be comfortable with his new carer who luckily was working with another recently rescued young gorilla. Djanga was also a year-old male and welcomed Shufai on their first encounter. He approached Shufai softly and was very gentle when they began to play. Shufai still had his left forearm bandaged from his surgery but this didn't deter their session as they trotted around investigating each other. The two young males eventually spent their quarantine together and were inseparable. This is where I first met Shufai and Djanga. Their keeper would spend days in the forest allowing them to play in the trees and forage on the forest floor. I was on site for a two month volunteer stay and brought with me some enrichment items I was hoping to use with the chimpanzees again. Luckily for me, the manager suggested trying the items with the two young gorillas in quarantine as well. What I had was acid-free paper donated by a professional framer and non-toxic paints. I was hoping to get some art work completed by the younger apes for a future fundraiser. We were all certain Shufai would not participate quickly, if at all, as he was an introverted youngster and very selective of new faces. Not too surprising after what he had been through thus far. Djanga was going to be the one who would take charge of this game; he loved everyone! Naturally, leave it to the gorillas to make a liar out of you. Shufai immediately took to the task when I introduced the paper with a few dabs of paint color. He would close his eyes, spinning around on the paint, all the while laughing and then would walk toward us bipedally, still with eyes closed. We managed to collect several pieces of artwork from him; a true bag of mixed media with the forest floor as our table. Djanga would always watch from the big tree as Shufai spun around, smearing his hands and slapping the paper, staying clear of the activity each time but definitely watching. The last day of painting Djanga must have known because he chose to participate as soon as we sat down. He began by slowly approaching the paper then touching the paint colors by smearing both hands and his body, also laughing as he played and spun around on the paper. We managed to get one masterpiece out of him. It was great fun for everyone, especially witnessing Shufai and Djanga form their friendship, a bond which continues today.

INTEGRATION

It was now time for Shufai and his best friend Djanga to meet their new group. Quarantine was complete and Shufai's wounds were healed. The group they were integrating with consisted of 3.4 gorillas aged two to six-years-old. With the exception of Yeba, all were orphans of the bushmeat trade. The enclosure, like all enclosures at AAA, is quite large and built right within their natural forest habitat with plenty of trees and brush. Attached to the front of the forest enclosure is a satellite holding which is used mainly for the gorillas' overnight sleeping quarters. With their keeper and the manager by their side, the new additions to the nursery group were accepted without incident and the gorilla group grew by two. You couldn't help but smile when venturing past their part of the forest because much laughter, chest beats and running footsteps could be easily heard. There was always a bit of inquisitiveness as well when walking past. Soon you would find yourself being followed by the entourage of little gorillas walking along the fence line. Not quite an ambush but more of huge curiosity before one by one they run off into the bush. Over the next couple years, the group of nine became eleven as more orphans arrived and the gorilla nursery received a brand new enclosure. The 100 x 100 meter forested space came complete with a brand new satellite holding area as well and was located further into the forest which provided even more lush trees to explore. Shufai, Djanga, Yeba and the others became a well adapted group of gorillas despite their difficult beginnings. As the manager would say, "babies raising babies", they had each other and nothing could replace a gorilla for a gorilla.

Shufai after surgery.
Photo by Dr. Sharon Redrobe of Twycross Zoo

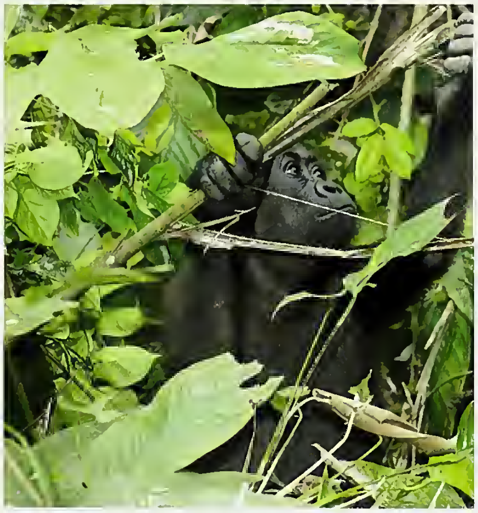
NEW ISSUES FROM OLD INJURIES

As Shufai grew, the project keepers and manager unfortunately began to notice a deformity materializing in the area of his original injury. Because of this discovery he was brought to a clinic in town for more x-rays, once again a task not easily achieved as clinics for humans aren't accepting of helping the gorillas. The x-ray pictures revealed the gun shot pellets damaged the growth plates, the region from which the bones grow in length. This type of injury, resulting in growth deformities to the forearm, is unfortunately not uncommon in apes poached in the wild, I'm told. Where bones are paired, as in the radius and ulna, they have to more or less grow at the same rate. As Dr. Sandra Corr further explained to me, "if one is damaged and stops growing while the other keeps growing, that joint associated with those bones (in this case the wrist), will often be pushed out of alignment. In Shufai's situation, his radius has mostly stopped growing on the medial side, but his ulna (and perhaps the little that's left of his lateral radius) has kept growing, effectively driving his hand round into a deformity." Since this type of radial club hand deformity seen in young children is corrected by complicated surgery, the project staff discussed Shufai's case with a few human surgeons who have had far more experience in dealing with this type of injury. Their recommendation returned that he would require the deformity realigned in both bones as well as providing stability. Ultimately, he was going to need more surgery.

The dilemma the project staff were facing now was exactly what type of surgery to perform. The suggestion was a closing wedge osteotomy which involved removing a triangular wedge of bone from the end of his radius, very close to the joint, closing the gap and then applying a bone plate. The procedure wouldn't stop there, he would also need the ulna shortened and then fixed with another bone plate. Not only is this major surgery to perform on a virtually wild gorilla, the manager and vet staff also were aware they would not be able to take any post-op radiographs to check if the position of the implanted plates and screws were sufficient. Furthermore, they would not be able to prevent him from walking on it immediately after the surgery and knew any sort of external support would be quickly torn off. Additionally, they weighed the risks of undertaking a more invasive and lengthy surgery while placing a lot of metalwork in what are very basic field conditions of sterility and considered the associated risks of infection. For these reasons the project staff felt it best to try the simplest option first, to perform a distal ulna osteotomy, removing about 5cm of bone in an attempt to prevent the deviation from progressing.

SURGERY NUMBER 2

Everyone worked together in converting the education area of the forest into a surgical theatre. The structure did have a roof but was wide open on all sides. Plastic tarps were hung over most open areas, not only for privacy but also to protect from insects and the sudden blast of rainfall should it appear. A wooden work table was transformed into the operating table. Folding tables were pushed together and covered with sheets to make the surgical prep area. All the necessary surgical equipment firmly inside their sterile packages was organized on the prep table. Cases of bottled water and brand new buckets were used for sterilizing the physician's hands since there isn't any running



(left) The women's group from Ape Action Africa. (right) Chickaboo on the forest floor selecting plants to eat.

water out in the forest. The project generator was powered up with extension cords and power strips in place. In order to keep an accurate record of this event there was also two cameras fully charged and ready to record the procedure. All that was needed now was Shufai. This is where the bond between his keeper and the project director became critical. The two walked alone to Shufai's enclosure. He was already waiting in the satellite holding. The director was able to orally sedate him; once he was asleep his keeper then was able to inject an anaesthetic. When the call came over the two-way radio to be ready, everyone made way for Shufai to arrive. Passing through the uneven terrain, avoiding the large pot holes and pushing through the dirt as to not lose momentum with such a heavy precious load, we could see the director, keeper and a wheelbarrow full of gorilla coming our way. The tarp-covered doorway was pulled aside to allow smooth, safe entry and quickly Shufai was placed on the makeshift operating table. Fortunately, one of the project trustees is a veterinarian from the UK and arranged for quite the surgical team to accompany her and assist. She was in charge of the anesthesia while AAA's project vet assisted with the two orthopedic surgeons. The procedure was like watching a well-rehearsed play, from the initial incision into Shufai's arm, to the electric saw actually cutting his bone, then removing the bone fragment and suturing him closed, was approximately 90 minutes. One would never guess this was their first time all working together; the doctors performed this major surgery in basic conditions flawlessly. Shufai was then quickly removed from the area and returned via wheelbarrow to his satellite holding with his keeper.

It didn't take long for Shufai to come around once his reversal drug was administered. The amount of substrate (mounds of aframomum stalks) covering the floor of his holding made for a soft surface while he managed to support himself. Although a little groggy, the determination he exhibited left us all thinking this was going to be a fast recovery. The entire vet staff would share in making rounds to check on him over the next few days. He was doing remarkably well and began putting weight on his left arm almost instantly. He was able to climb all around the satellite holding with little to no effort and was interacting with his group through the mesh. It was only a matter of days before he was back with his family and foraging around in his enclosure again. The procedure certainly appeared to be a success.

CONCLUSION

The second surgery Shufai underwent was in February of 2012, six years after the original injury. By the end of 2012 it became apparent this procedure unfortunately didn't have the desired effect. Whereas Shufai did appear more comfortable initially after the surgery, eventually signs of irritability started to surface once more. The bone, which had five centimeters of it removed, has virtually healed again with a big bony callus. Definitely not the outcome everyone had hoped for. The project staff waited for additional information from the surgeons before deciding their next course of action. Meanwhile, Shufai was given a course of pain medication to make him more comfortable. By the end of February 2013, the surgical team was preparing for their forest return. Twycross Zoo had arranged for an x-ray machine, funded by Chessington World of Adventures, to be delivered to the project. This would help immensely with the much needed radiographs. Early March 2013, after weighty consideration and contemplation, they had to make the difficult decision to amputate Shufai's left arm below his elbow. The operation was performed within an improvised surgical theatre, again at the forest project site. The news of his recovery has been excellent so far. He has been active and is in good spirits, laughing and playing, resilient as ever. He will be monitored closely and has access to his group through the satellite mesh.

Cases like this are only one of the many difficulties projects such as Ape Action Africa face. Bushmeat orphans are increasing in numbers and most sanctuaries are at capacity. When projects come to the aid of these orphans it can result in a lifetime commitment, especially when their injuries are drastically debilitating.

ACKNOWLEDGEMENTS

Many thanks to Dr. Sandra Corr for her contribution and for explaining the details surrounding Shufai's second surgery. Your expertise is invaluable and your composure during the procedure remarkable; I remain grateful for the experience to witness this first hand. Special thanks to the AAA director, manager, staff and trustees, your commitment and dedication will always be one of my greatest inspirations.

REFERENCES

Stanford, C. 2012. Planet Without Apes. *Bushmeat* 3:89, 92-93

For more information about Ape Action Africa and Shufai:
Website: *apeactionafrica.org*
Facebook: *https://www.facebook.com/ApeActionAfrica*
twitter: *@apeactionafrica*
Pinterest: *pinterest.com/apeactionafrica/*

A Hole-in-One For Conservation:

Hosting a Gorilla Golf Fundraising Tournament

Jodi Carrigan - Primate Keeper and ACE Board Member
Zoo Atlanta, Atlanta, GA

When I first heard OKC Zoo has been hosting gorilla golf tournaments to raise gorilla conservation funds, I thought it was a great idea. In 2010, a group of dedicated keepers, docents and others in Atlanta started an all-volunteer organization called Ape Conservation Effort (ACE), "a Georgia not-for-profit 501(c)(3) corporation, comprised of volunteer members who share a passion for animals and a commitment to saving the great apes (bonobos, chimpanzees, gorillas, and orangutans)." See www.apeconservationeffort.org for more information.

In 2011, ACE decided to try its hand at its own golf tournament – with a slight twist. Instead of hosting a tournament with 75+ participants, we increased the entry fee amount of the golfer and made the format similar to a golf-a-thon. Each golfer needed to raise $1000.00 in sponsorships. The first year we only had eight players and by proceeds from sponsorships as well as from an ACE-hosted raffle when the players came in from golfing, we made a profit of $9758 to support gorilla conservation.

The second year we lowered the entry fee to $500.00 per golfer. We had 12 golfers and thanks to the raffle and several overachieving golfers who raised more than the minimum needed, we grossed $14,574, of which $13,248 went directly to the Dian Fossey Gorilla Fund International (DFGFI) to fund an anti-poaching patrol unit for a gorilla group for a whole year.

Costs are minimal. We requested donations for raffle items such as golf clubs, club covers, decorative baskets of golf-related items, small electronic devices, and give-away bags containing golf tees, golf balls, t-shirts, and other small items. We also solicited for hole sponsors. A company gets its business name and logo printed on a sign at the start of a hole. We found a company that charged $20 a sign, and we were able to charge $100 per hole. If they sponsored the following year, we already had their sign, which brought in $100 profit per sponsor. Since our golf numbers were small, the golf course was willing to donate a lot of its resources. Many courses are willing to donate to the community. It doesn't hurt to throw in some zoo tickets and even a tour. Our cost at Brookfield Country Club in Roswell, Georgia is $65 per player, which includes golf, golf cart, buffet breakfast, lunch and drinks. Having a small number of participants keeps costs low and thus raises more money for gorilla conservation.

A hands down favorite prize of the golfers who won First, Second, and Third place, the Longest Drive hole and the "Closest to the Gorilla" hole are gorilla painted plaques, which provide a great conversation piece in their offices. Each colorful plaque has a bronze plate with the gorilla artist's name and information affixed to the back.

The sizeable donation that was made last year to DFGFI allowed ACE to be a part of The Gorilla Council, which gave us such benefits as a radio spot from Sigourney Weaver thanking our organization for supporting gorilla conservation, designation of where our money goes, direct feeds of conservation news and stories to use in our publications and social media as well as personalized help from a DFGFI staff member to help make our event a success.

If you would like more information about organizing and hosting a Gorilla Golf Tournament, please contact Jodi Carrigan at jcarrigan@zooatlanta.org. Makes for a great AAZK fundraiser!

Closest to the gorilla hole wins a prize. *Photo by Lisa Dempsey*

Having a small number of participants keeps costs low and thus raises more money for gorilla conservation.

Gorilla Golf door prizes. *Photo by Lisa Dempsey.*

2012 Gorilla Golfers supporting gorilla conservation.
Photo by Lisa Dempsey.

Africa's Most Endangered Ape:

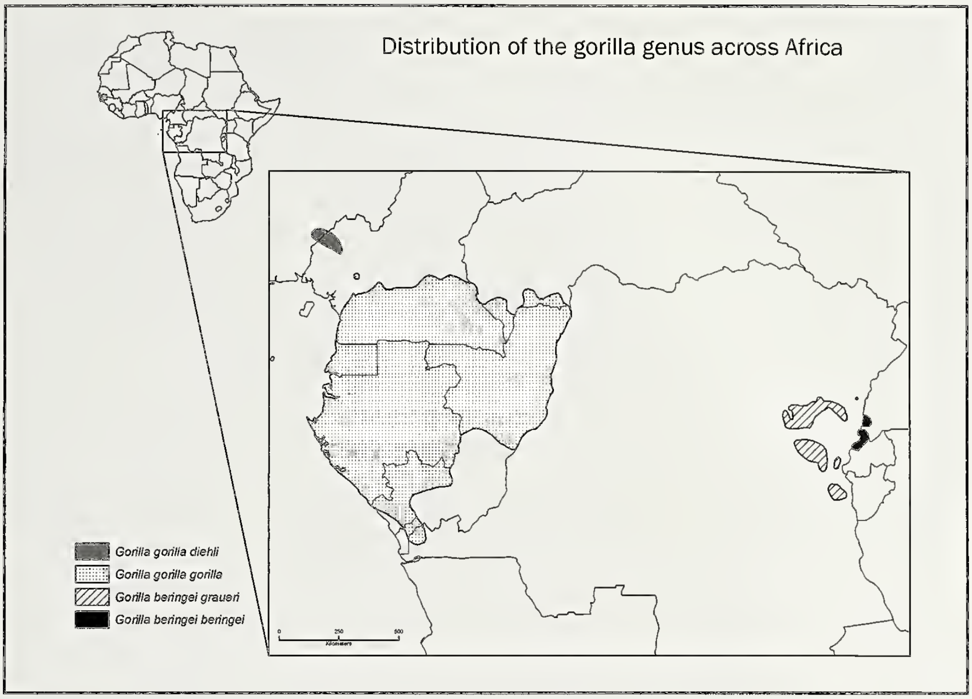
Using technology and partnerships to save the critically endangered cross river gorilla

Richard Bergl, PhD,
Curator of Conservation and Research • North Carolina Zoo

The Cross River gorilla (*Gorilla gorilla diehli*) inhabits the tropical forests of the Nigeria-Cameroon border region in western central Africa. This region is one of the most biodiverse areas in Africa, and contains large numbers of both endemic and endangered species. Many of the amphibians, birds and other species found in the region's forest occur nowhere else on earth.

The gorillas are named after the Cross River, which has its headwaters in the hills and mountains where the gorillas are found. The northern and western-most gorilla population, these gorillas are separated from other gorilla populations by approximately 200 km.

The Cross River gorilla is one of the four currently recognized subspecies of gorilla, and is ranked as one of the 25 most endangered primates in the world. Indeed, the gorillas of the Cross River region had been thought to be largely extinct until they were rediscovered in the early 1980s. Recent surveys suggest that the total population likely numbers fewer than 300 individuals, less than half the number of remaining mountain gorillas (*Gorilla beringei beringei*).



THREATS

The Cross River gorilla, like many of the species in Central and West Africa, is threatened primarily by bushmeat hunting and habitat loss. The Cross River region has one of the highest human population densities in Africa, placing extremely high pressure on the area's forests and other natural resources. Even though commercial logging is banned on the Nigeria side of the border and heavily regulated on the Cameroon side, significant illegal logging occurs. While logging is a threat, the greatest loss of Cross River gorilla habitat comes from the conversion of forest for agriculture. Slash and burn

(Opposite page) Field testing of the mobile field computers in Nigeria.

(Right) The only Cross River gorilla in captivity: "Nyango" photographed in Cameroon's Limbe Wildlife Center © *N. Lankester.*

(Below) *Hyperolius riggenbachi* – the Cameroon slippery frog © *M. Gartshore.*

agriculture is the predominant form of cultivation in rural areas. This means that large areas of forest are cut down and turned into farmland every year.

The greatest threat to the Cross River gorillas themselves is bushmeat hunting. Communities living in the Cross River region have hunted wild animals for meat for a long time. However, modern human population densities in both rural and urban areas are so great that this hunting is not sustainable. A lot of bushmeat is no longer consumed in rural communities, but is instead transported to large urban markets. In addition to meat, gorilla body parts are used in traditional medicine and can fetch high prices in urban markets.

ELUSIVE APES

The small size of the Cross River population is likely the result of intensive bushmeat hunting over many generations. Historically, high levels of hunting mean that the gorillas are now very wary of people and found almost exclusively in very rugged and inaccessible highland sites.

The remoteness of these areas, coupled with very challenging terrain, provides some level of protection for the gorillas, but also makes life difficult for park rangers and other conservationists working to preserve this population. In order to collect data of conservation relevance, field researchers and protected area staff must spend many weeks tracking the gorillas through thick tropical forest and up and down precipitous mountain slopes. Even then, the Cross River gorilla is rarely observed and most data collection relies on indirect evidence such as feeding signs and nest sites. The Cross River gorilla has only been photographed in the wild a handful of times. As a result of their reclusive nature and the difficult environment in which they live, determining even basic information like the range of this subspecies has proved extremely difficult.

A WCS gorilla monitor records data at a Cross River gorilla nest site.

APPLYING GEOGRAPHIC INFORMATION SYSTEMS AND GPS TO CONSERVING THE CROSS RIVER GORILLA

In 2007, the North Carolina Zoo formed a partnership with the Wildlife Conservation Society (WCS) to help conserve the Cross River gorilla population. Building on previous research and WCS's many years of conservation work on the ground in Nigeria and Cameroon, the partnership set out to apply a range of geographic information system (GIS) and global positioning system (GPS) technologies to efforts to preserve the Cross River gorilla. One of the key things to understand in working to conserve these gorillas is their distribution relative to both existing habitat and human activity in the forest. Gaining this understanding is more difficult than it sounds since gorillas are distributed across a large, remote and complex landscape for which few accurate maps exist.

In order to begin to address these challenges, the North Carolina Zoo worked with WCS to establish two GIS computer mapping facilities in Nigeria to help guide conservation efforts. These facilities use a range of satellite images to provide detailed maps of the range of the Cross River gorilla. For some areas (such as the Afi Mountain Wildlife Sanctuary in Nigeria; one of the first sites where the gorillas were studied) the satellite images are so detailed that they can discriminate individual trees and small houses in rural villages. The zoo provided computer hardware and trained local staff in basic mapping and data analysis techniques. The mapping systems are now being used to plan field work and analyze data essential for protecting the gorillas.

PUTTING SOPHISTICATED GPS TECHNOLOGY IN THE HANDS OF FIELD RESEARCHERS AND PARK RANGERS

The North Carolina Zoo-WCS partnership has taken these geographic technologies out of the office and into the field. Formerly, much of the data collected in the field by research and protected area staff was done using pen, paper and consumer-GPS units, just like the ones commonly used for outdoor recreation. This method of data collection requires a great deal of training, especially for staff with limited scientific background, and can produce inconsistent results. To remedy this situation, we developed a new way of recording biological data in the field based on highly rugged mobile computers and a software package called Cybertracker. The Cybertracker software was originally developed to allow illiterate trackers in South Africa to collect wildlife monitoring data. It uses a touch screen and GPS antenna to collect data systematically and with spatial information to allow mapping. The software also allows field workers to map their activities in real-time on satellite maps, allowing them to know exactly where they are, even in the most remote forests.

With financial support from the U.S. Fish and Wildlife Service, AZA's Conservation Endowment Fund, and the North Carolina Zoological Society, the North Carolina Zoo-WCS partnership began development and testing of the Cybertracker-based system in 2008. Since the mobile computers were to be used in a very difficult environment (high humidity, high temperature, frequent exposure to dirt, rain and impact), we extensively field tested a number of different options before deciding on the final hardware platform. We also consulted carefully with many of the field workers who would actually be using the devices to ensure that the system both captured the necessary data and would be easy to operate and understand.

CYBERTRACKER IN ACTION

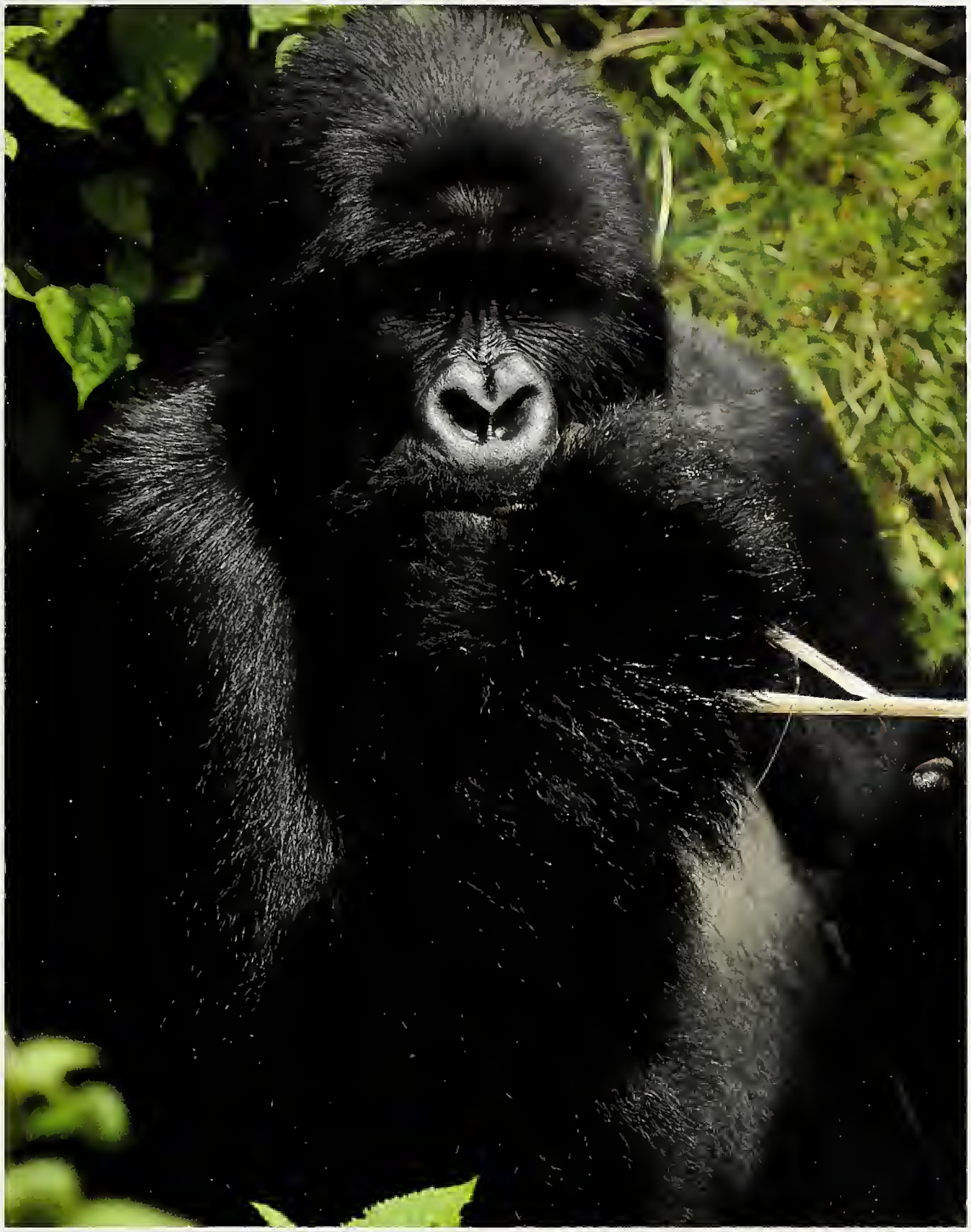
The finished system has been deployed to both Cameroon and Nigeria and has been in operation for over four years. The Cybertracker units are used by WCS and government field staff across the range of the Cross River gorilla. The units are used to collect important data on the gorillas, other wildlife and human impacts on the region's forests. These data allow for more efficient and effective management of the Cross River gorillas' habitat and are a good monitoring tool for conservation initiatives throughout the region. At several sites we have been able to use the system to document reductions in the levels of illegal activity in the forest as a result of Cybertracker-based patrolling.

The system has been so successful that we have adapted it for use in a number of other conservation projects. Cybertracker devices are being used to monitor elephants and poaching in Nigeria's Yankari Game Reserve, home to the country's last viable population of elephants.

Off the coast of Cameroon on the remote island of Bioko, NC Zoo has helped researchers from Drexel University apply Cybertracker to surveys of a number of endangered monkey species. Among these species is the critically endangered drill (*Mandrillus leucophaeus*)

In partnership with the Dian Fossey Gorilla Fund International and Cleveland Metroparks Zoo, we have recently used the system to monitor mountain gorillas (*Gorilla beringei beringei*) in Rwanda. This project has even extended the system for use in large mammal and bird surveys. It is even being applied to monitoring bamboo, one of the mountain gorillas' preferred foods.

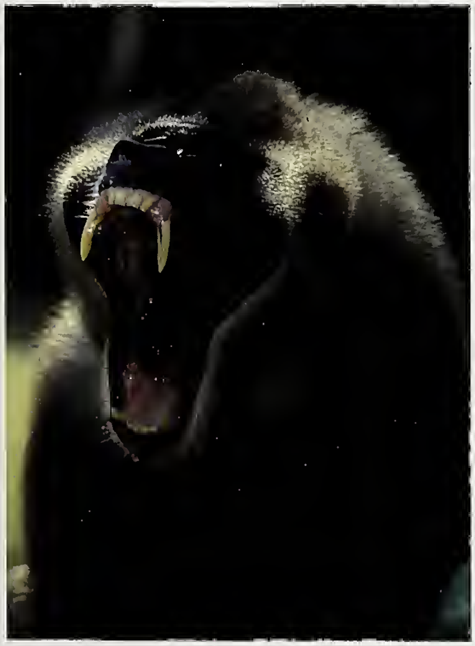
A combination of cutting edge technology and on the ground field work has allowed us to make field data easily and directly applicable to the conservation of gorillas and a number of other species. What started out as a project focused on 300 Cross River gorillas has expanded to a number of other countries and conservation contexts. The Cybertracker project is just one of many examples of how AZA institutions like the NC Zoo are actively contributing to the conservation of wildlife.

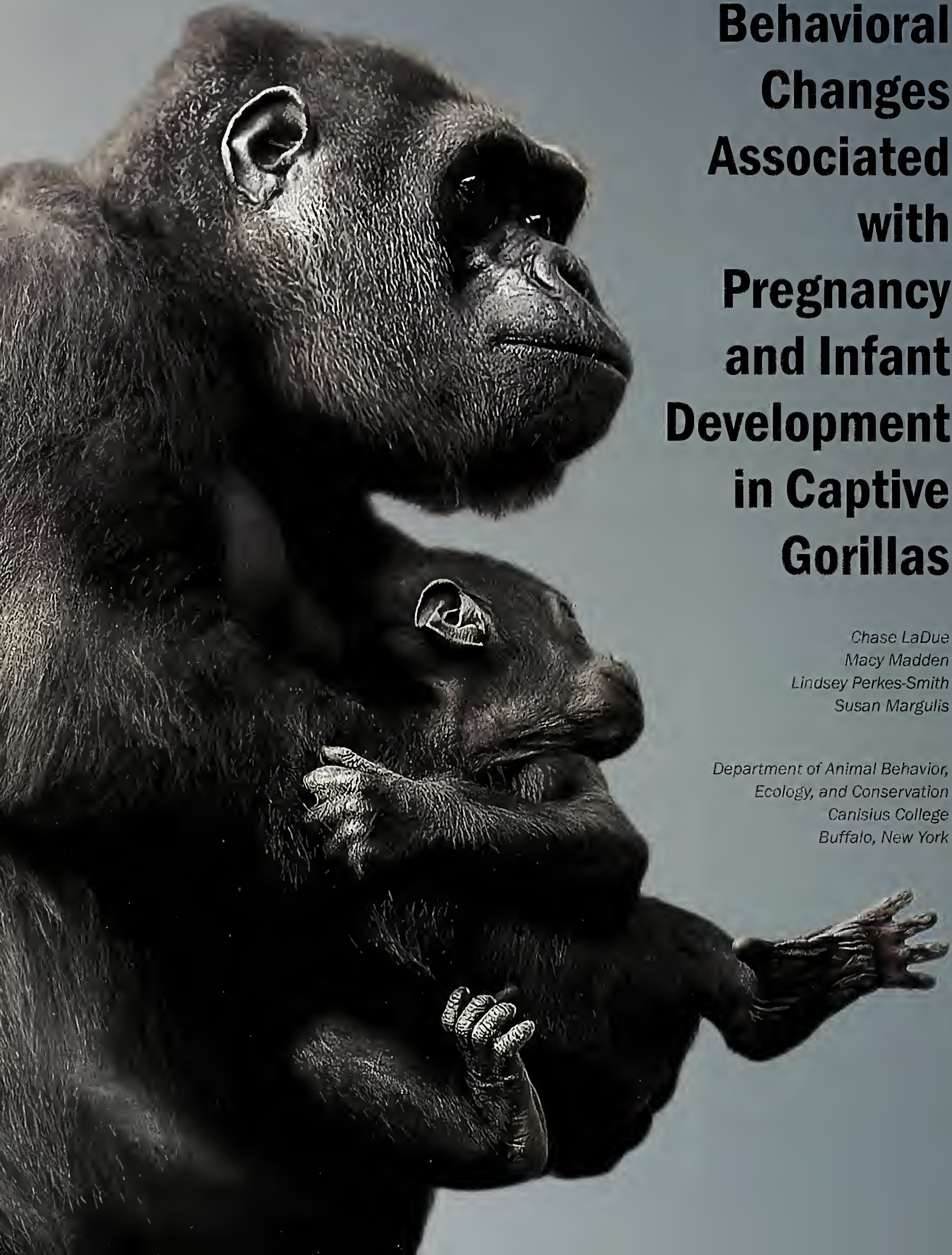


(right) A silverback mountain gorilla in Rwanda's Volcanoes National Park.

(below) Drills are particularly effected by bushmeat hunting.

(bottom right) Elephant herd in Yankari Game Reserve, Nigeria.





Behavioral Changes Associated with Pregnancy and Infant Development in Captive Gorillas

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Macy Madden
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Susan Margulis

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INTRODUCTION

As conditions in captivity improve, and our understanding of reproductive biology becomes greater, the prevalence of successful primate births continues to increase, and certainly, gorillas are no exception (Hosey 2005, Snowdon 1989). In 2010, there were 21 successful western lowland gorilla (*Gorilla gorilla gorilla*) births internationally in zoos, six of which were in the United States (Wilms 2011). Nonetheless, our base of knowledge is still growing, and although it is common for detailed veterinary information to be recorded upon each birth, changes in behavior over extended periods of time—in regards to both mothers and their infants—are rarely documented systematically or objectively.

To our knowledge, only one other study has assessed the behavioral changes associated with pregnancy in captive gorillas: Meder (1986) conducted a study which compared the physical and activity changes of five gorillas over fourteen pregnancies at two German institutions. In terms of behavior, it appears that female social activity decreases within the first three months of pregnancy. Additionally, the author suggested that behavioral, and not physical, changes are the most reliable signal in determining gorilla pregnancy. This is especially relevant to all zoos housing female gorillas, as it illustrates that inexpensive behavioral records can be taken in order to reliably identify pregnancy.

One of the methods through which zoo personnel can observe and review behavior is behavioral monitoring, a process by which observers objectively measure and record an animal's behavior on a regular basis (Watters et al. 2009). In doing so, a behavioral baseline is established, and the effects of any environmental changes can be analyzed accordingly. Observations made by keepers or other observers do not necessarily have to occur frequently; regular, shorter observations can provide a behavioral baseline and, over time, portray an accurate and quantitative picture of behavior. When applied to zoo animals, behavioral monitoring can be a valuable tool for keepers, curators, researchers, and others, because it allows for an evaluation of an animal's behavioral response to environmental changes, such as births, deaths, transfers, and exhibit changes.

The purpose of this project was to systematically characterize the behavioral changes in a captive female gorilla before, during, and after pregnancy, and to track the behavioral development of her infant over time. By documenting the behavioral progression of both mother and infant, each pregnancy and birth can be compared with other institutions holding gorillas in order to establish norms of behavior and development. There are few published studies on the effects that pregnancy and motherhood have on a gorilla's behavior, so an additional goal of the project was to contribute to a growing pool of practical knowledge (Beck 1984, Clift and Martin 1978, Hoff et al. 1981). In the current study, the mother had never given birth before, so any information could potentially be used for future offspring, and this would certainly be beneficial for the institution and researchers alike.

In 2009, an undergraduate research team from Canisius College (Buffalo, New York) began collecting behavioral data on a captive troop of gorillas at the Buffalo Zoological Gardens for a behavioral monitoring database. One of the gorillas ("Sidney," SB# 1449) became pregnant in February 2010 and gave birth to a female offspring ("Amari," SB# 2029) on October 8, 2010. Our baseline data gave us the opportunity to quantify changes in both mother and infant behavior. At the time of submission, and to our best awareness, this is the only study that simultaneously examines behavioral changes in both a mother gorilla and her infant. In regards to the mother, we expected to observe differences in activity budget and sociality due to pregnancy and motherhood. For the infant, we expected to note a progressive increase in independence, accompanied by changes in overall activity budget.

METHODS

Behavioral data were collected from September 2009 through the first year of Amari's life, until November 2011. At the time of pregnancy, Sidney was 12-years-old, and shared an enclosure with an adult male silverback ("Koga," SB# 967, 22 years) and two adult females ("Becky," SB# 778, 28-years; and "Lily," SB# 1575, 9-years). Becky passed away in March 2011 and so was excluded from analysis. Observation sessions were conducted three to seven times weekly, with each animal observed through focal animal scan sampling for twenty minutes during normal visitor hours at public areas. Scans during each session were one minute apart, and at each scan, behavior, location, and social distance were recorded. All data were collected using trained student observers with EthoTrak behavioral monitoring system programmed on handheld PDAs.

In order to assess any behavioral changes from Sidney, we separated data into three periods: pre-pregnancy (September 2009 through January 2010), pregnancy (February 2010 until October 8, 2010), and post-birth (October 8, 2010 through October 2011). To gauge Sidney's interest in other gorillas across the three periods, all instances of approach between two animals were recorded, along with which gorilla initiated the approach and which was the recipient of an approach. As an additional measure, with each behavior scan, a "neighbor," if present, was recorded; any individual within one meter of the focal animal was considered a neighbor. To evaluate Amari's behavior, the first year of life was divided into quarters for analysis. As with her mother, approach behaviors and neighbor data were recorded as an indication of Amari's growing independence from Sidney. We used an ANOVA (with a comparison of means) to statistically evaluate neighbors, Kruskal-Wallis tests for activity budgets, and chi-square tests for approach behavior.

RESULTS: SIDNEY

Figure 1 shows Sidney's activity budget across the three time periods (pre-pregnancy, pregnancy, and post-birth). The frequency of locomote and out-of-view behaviors differed significantly across the three time periods: Sidney locomoted progressively less following the pre-pregnancy period (Kruskal-Wallis test, $\chi^2 = 18.0524$, DF = 2, $P < 0.0001$), and she was out of view more during her pregnancy ($\chi^2 = 18.2290$, DF = 2, $P < 0.0001$).

Figure 1: Sidney's Activity Budget

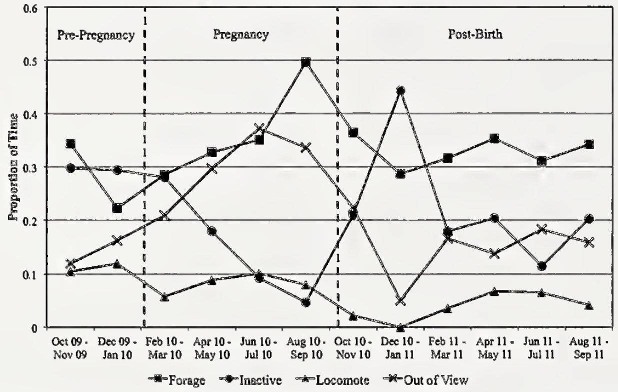


Figure 2 shows the approach behavior between Sidney and Koga (the silverback), with the proportion of interactions initiated by Sidney in white and Koga in black. Sidney was the initiator of significantly more approaches during the pre-pregnancy period ($\chi^2 = 6.231$, DF = 1, $P < 0.025$). However, significant differences in the initiation of approaches were not found in the subsequent time periods.

Figure 2: Approach Behavior, Sidney and Koga

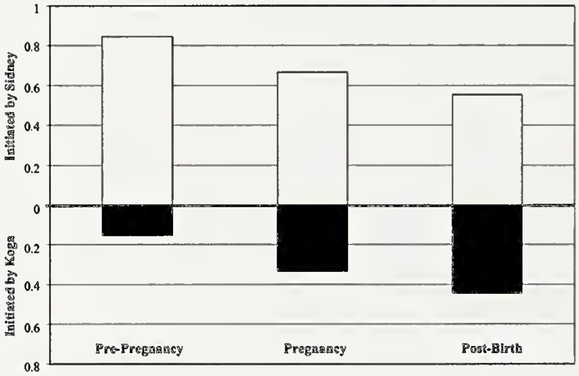
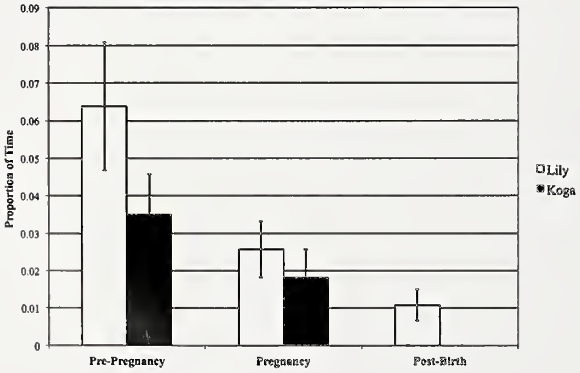


Figure 3 shows the frequency of neighbors to Sidney (Lily, adult female, in white, and Koga in black), with standard error bars. Statistical analyses showed that there was a significant decline in frequency with which Lily was a neighbor over the three time periods ($F = 7.083$, DF = 2, $P < 0.001$), but not with Koga. Sidney spent little time in close proximity to others.

Figure 3: Sidney's Neighbors, Lily and Koga



RESULTS: AMARI

Figure 4 illustrates the proportion of time that Amari spent as a neighbor to her mother. Black bars indicate proportion of time spent in contact with mother, gray bars show time spent within one meter of Sidney, and white bars designate time spent greater than one meter from Sidney. Statistical analysis indicated that she spent significantly less time in contact with Sidney during the fourth quarter (July 2011 through October 2011) ($F = 24.14$, DF = 3, $P < 0.0001$ with post hoc comparison of means, Duncan's multiple range test).

Figure 4: Amari's Proximity to Sidney

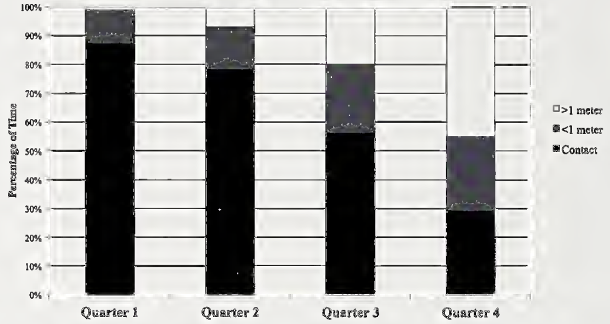


Figure 5 shows the activity budget for five principal behaviors throughout Amari's first year of life: being carried, foraging on solid food, locomoting, playing with objects, and suckling. Statistically significant differences were found for foraging, locomoting, and playing across the four periods, while differences between being carried and suckling were not statistically significant. Amari foraged significantly more as she began to develop throughout the year (Kruskal-Wallis test, $\chi^2 = 28.15$, DF = 3, $P < 0.0001$). She also increased independent movement as she aged ($\chi^2 = 28.84$, DF = 3, $P < 0.0001$). Lastly, Amari played significantly more as time went on ($\chi^2 = 32.61$, DF = 3, $P < 0.0001$). These behaviors occurred significantly more during the third and fourth quarters than during the first and second quarters (Duncan's multiple range test).

Figure 5: Amari's Activity Budget

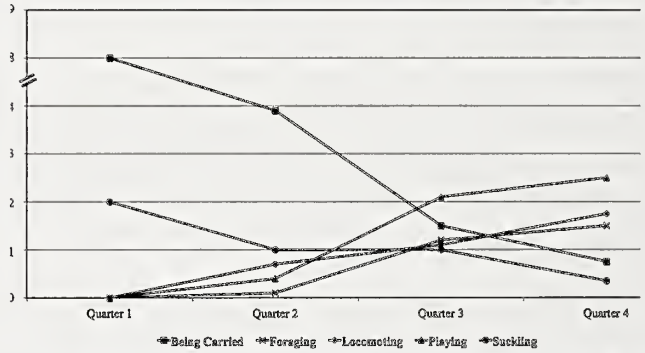


Figure 6: Approach Behavior, Amari and Sidney

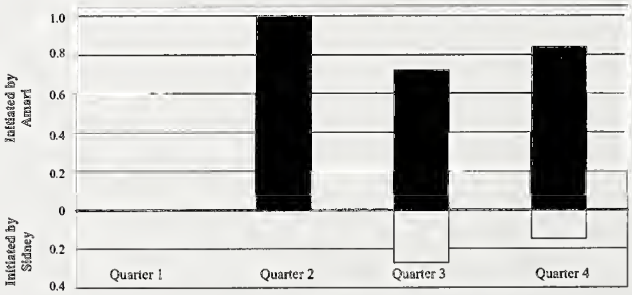


Figure 6 shows the relative frequencies with which Amari and Sidney initiated approaches to each other. Approaches initiated by Amari are shown in black, while white bars represent approaches initiated by Sidney. Amari initiated significantly more approaches in the fourth quarter, July 2011 through October 2011 ($\chi^2 = 7.14$, DF = 1, $P < 0.01$).

DISCUSSION

Our results suggest that Sidney's behavior changed during the course of her pregnancy. As expected, she locomoted less during her pregnancy and was out of view of the public more often. More than likely, Sidney was probably inactive while out of view, although we cannot confirm this with complete certainty. These results are in accordance with Meder's study (1986). The data also suggest that pregnancy and motherhood affected Sidney's social behavior: specifically, she interacted less with conspecifics after her pregnancy and following the birth of Amari. Before the pregnancy, Sidney initiated significantly more approach behaviors towards Koga (the silverback), but during and after the pregnancy, the two initiated about the same number of approaches. This is reasonable: females that are already pregnant should show no sexual interest in directly interacting with the silverback. Additionally, neighbor data show that Sidney spent progressively less time in close proximity to Koga during and after her pregnancy. Interestingly, she also spent less time in proximity to Lily, the other adult female in the group. This may be attributed to Sidney's protectiveness towards Amari. Unfortunately, we cannot compare social behavior in regards to another female conspecific to confirm or refute this. Nonetheless, the data indicate that Sidney engaged in less social activity following the pre-pregnancy period.

> Because the future of the captive gorilla population is dependent upon continued breeding success, especially from genetically-unique individuals, it is critical that every birth be closely monitored.

Regarding Amari's behavior, there appeared to be a substantial behavioral shift after six months of age (between Quarters 2 and 3). Specifically, behaviors associated with a growing state of independence, such as foraging on solid food, locomoting, and playing, increased in occurrence as time progressed. Additionally, Amari spent time further away from her mother as time progressed. It should also be noted that after six months of age, Sidney initiated approaches to Amari, which had never been observed during the first six months of life. Therefore, the period around six months of age seems to be a significant milestone for a gorilla infant, characterized by growing independence from mother and an increase in the frequency of more active, individualistic behaviors.

Because the future of the captive gorilla population is dependent upon continued breeding success, especially from genetically-unique individuals, it is critical that every birth be closely monitored. We have shown that data obtained via behavioral monitoring are reliable indicators as to any changes in activity patterns, changes that may be more valid than any physical signs. We suggest that all institutions housing gorillas, and any other species of interest, should employ some form of behavioral monitoring. This method is an important tool for zoos, because it allows for the effects of any environmental changes to be compared against baseline data. While this project was conducted using a larger research team, a smaller group of keepers can certainly perform similar observations with fewer resources and less time commitments. Observation sessions need not happen more than once a week if time constraints are present, and behavioral observations recorded in daily keeper reports can also be useful to extract information through one-zero sampling (Powell 2008).

If nothing else, efforts to conduct behavioral monitoring during critical periods—such as during pregnancy or following a birth—should provide an institution with knowledge that can affect both the daily husbandry and long-term management of an individual. For instance, if a pregnant gorilla doesn't seem to be active progressively less, or if an infant does not show significant signs of independence after six months of age (both of which were found in this study), these could serve as an early warning of potential problems. These issues may not present themselves via physical signals, and it is in these instances that behavioral monitoring is crucial.

ACKNOWLEDGEMENTS

First and foremost, we would like to gratefully acknowledge the hospitality and support of the Buffalo Zoological Gardens, especially President Dr. Donna Fernandes, General Curator Gerald Aquilina, and the dedicated keepers of the Gorilla Forest. We would also like to extend gratitude to the Canisius College students who helped in collecting data. This work was supported in part through the Canisius Earning Excellence Program fellowship.

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REFERENCES

Beck, B.B. 1984. The Birth of a Lowland Gorilla in Captivity. *Primates* 25(3):378-383. Springer Science+Business Media, Berlin, Heidelberg, Germany.

Clift, J.P., and R.D. Martin. 1978. Monitoring of Pregnancy and Postnatal Behaviour in a Lowland Gorilla (*Gorilla gorilla gorilla)* at London Zoo. *International Zoo Yearbook* 18(1):165-173. Zoological Society of London, London, England, U.K.

Hoff, M.P., Nadler, R.D., and T.L. Maple. 1981. The Development of Infant Play in a Captive Group of Lowland Gorillas (*Gorilla gorilla gorilla*). *American Journal of Primatology* 1(1): 65-72. American Society of Primatologists, U.S.A.

Hosey, G.R. 2005. How Does the Zoo Environment Affect the Behaviour of Captive Primates? *Applied Animal Behaviour Science* 90(2):107-129. International Society for Applied Ethology, Penicuik, Midlothian, U.K.

Meder, A. 1986. Physical and Activity Changes Associated With Pregnancy in Captive Lowland Gorillas (*Gorilla gorilla gorilla*). *American Journal of Primatology* 11(2):111-116. American Society of Primatologists, U.S.A.

Powell, D. 2008. *Methods for Animal Behavior Research* [DVD]. Wildlife Conservation Society. New York, New York, U.S.A.

Snowdon, C.T. 1989. The Criteria for Successful Captive Propagation of Endangered Primates. *Zoo Biology*. Vol. 8, Issue Supplement: 149-161. Association of Zoos and Aquariums, Silver Spring, Maryland, U.S.A.

Watters, J.V., Margulis, S.W., and S. Atsalis. 2009. Behavioral Monitoring in Zoos and Aquariums: A Tool for Guiding Husbandry and Directing Research. *Zoo Biology* 28(1):35-48. Association of Zoos and Aquariums, Silver Spring, Maryland, U.S.A.

Wilms, T. 2011. *International Studbook for the Western Lowland Gorilla*. Frankford Zoo, Frankford, Germany.

Where the Silver Ends and the Gray Begins:

Caring for Geriatric Silverbacks and Older Female Gorillas

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Zoo Atlanta, Atlanta, GA

Zoo Atlanta is home to 19 Western Lowland Gorillas *(Gorilla gorilla gorilla)*, one of the largest collections in North America. We currently have three geriatric gorillas aged 50 and older, all of whom were wild caught. Our oldest male Ozoum (Ozzie), is 52-years-old and he lives with 0.1 Choomba who is 50-years-old and 0.1 Shamba who is 54-years-old. Ozzie is currently the oldest living male gorilla in captivity.

Thanks to improved husbandry and veterinary care, gorillas are living longer in captivity. As these animals age, there are certain challenges to keep them healthy and with a good quality of life. Many animals experience decreased mobility as they age due to conditions like arthritis. Over the years, Zoo Atlanta has made several modifications to our holding areas to accommodate arthritic gorillas.

To aid in husbandry, many of the indoor holding areas already had large rungs attached to the wall or ladders attached to the mesh to facilitate climbing up to nesting shelves or to upper shift doors. In addition to these fixtures, we have also made concrete steps on the inside and outside of shift doors to ease access to the building. *(Figures 1 and 2)*

Another modification that has been made to help with climbing in and out of upper shift doors or nesting shelves is adding lengths of chain that run through PVC pipe and are then suspended from the ceiling. In one holding we also have a ramp leading up to a shelf. Firehose can also be used to aid in climbing and we even constructed a ladder made of firehose with PVC in the rungs to be more stable. Hammocks can be lowered near the floor and some of the gorillas enjoy dunnage racks to rest on as well. *(Figures 3, 4 and 5)*

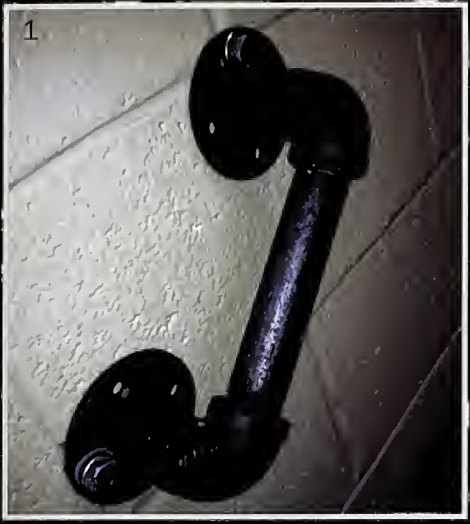
Given the sensitivity older animals have with their joints, we use foam gym mats for gorillas while recovering from anesthesia. This is particularly helpful for animals that try sitting up too early and may fall back down. These mats have come in handy for ill gorillas as well to add extra padding under hay or wood wool (excelsior).

We have had to be inventive when animals are not able to get close enough to the mesh to eat, drink or take medications. The "geriatric spoon" is a spoon on a long broom handle and the "geriatric straw" is a PVC tube with an elbow bend at one end. *(Figures 6 and 7)*

Geriatric gorillas also need to be monitored carefully for heart disease which is the number one cause of death in captive gorillas. In partnership with The Great Ape Heart Project and sonographers from Children's Healthcare of Atlanta (CHOA), we have been training for voluntary cardiac ultrasounds and voluntary blood pressure readings. This will enable veterinary staff to catch potential problems earlier as well as tracking individuals who currently have heart disease. Some gorillas have difficulty getting their chests up close to the mesh, so we created a "Reverse Sleeve" for easier access. *(Figures 8, 9 and 10)*

We have been looking into starting laser treatments for gorillas with arthritis, and have begun training with several gorillas to accept having the laser probe near them. On occasion we have used radiographs to check hands or wrists for arthritis. We fitted a PVC sleeve for use with our portholes and Veterinary staff was able to set up a portable x-ray machine to get images.

In conclusion, there are any number of ways to help make life easier for the aging gorillas in our care. It doesn't have to be expensive, it just takes a little forethought and creativity.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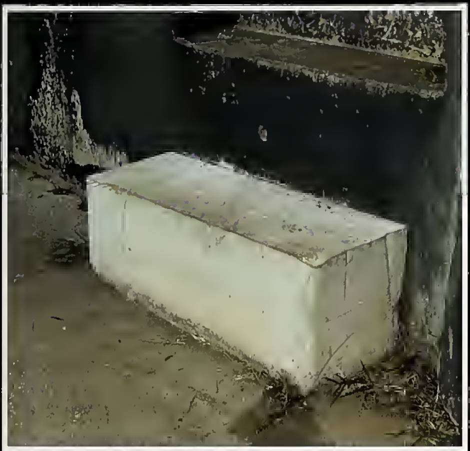

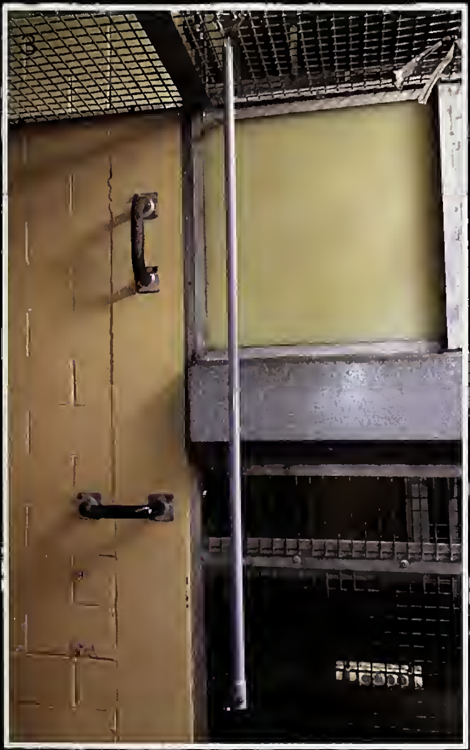

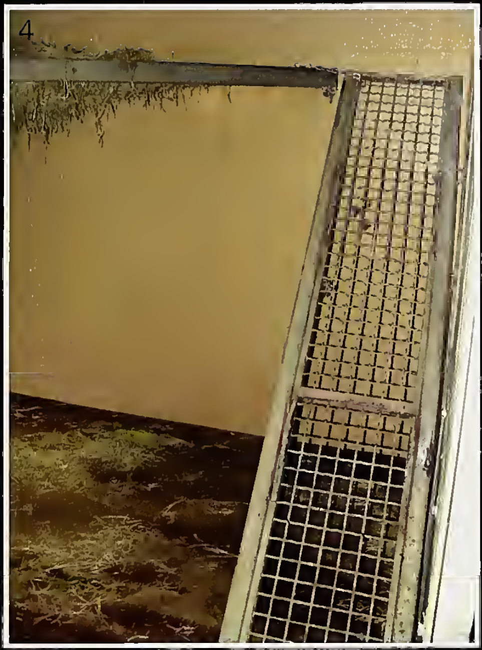
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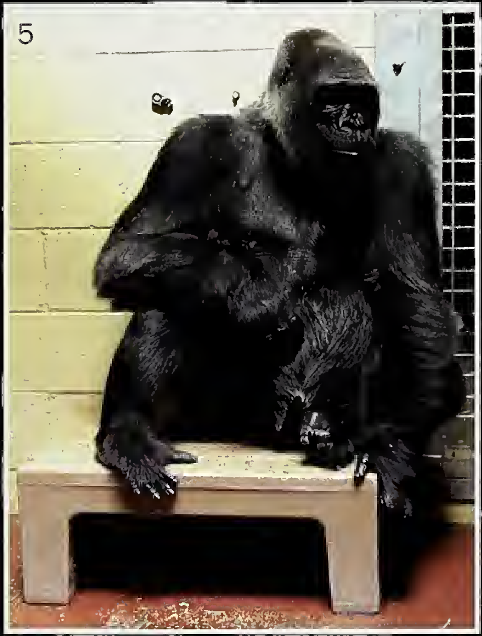
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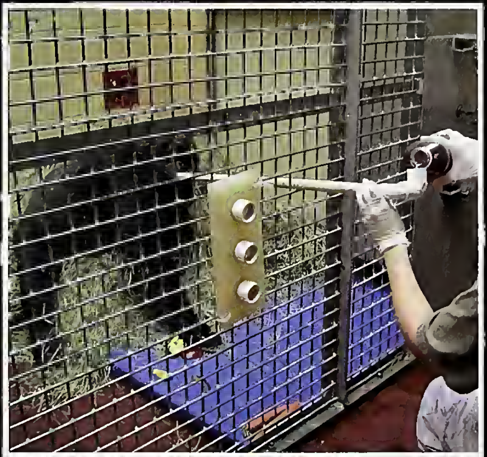

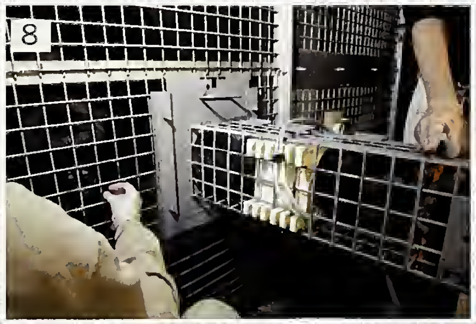
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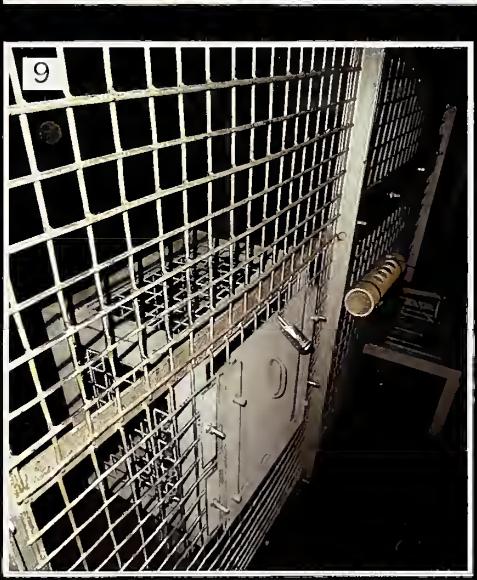
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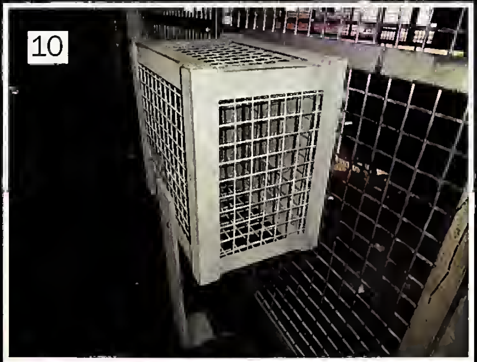
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Figure 1: Wall rung made in-house. *Photo by Jodi Carrigan.* Figure 2: Cement step made in-house. *Photo by Jodi Carrigan.* Figure 3: PVC pipe covering chain made in-house. Also shows rungs that were manufactured. *Photo by Jodi Carrigan.* Figure 4: Mesh ramp. *Photo by Jodi Carrigan.* Figure 5: 0.1 Choomba enjoying a Dunnage (TM) rack. *Photo by Jodi Carrigan.* Figure 6: Geriatric straw made in-house. *Photo by Jodi Carrigan.* Figure 7: Geriatric spoon made in-house. *Photo by Jodi Carrigan.* Figure 8: 1.0 Charlie participating in blood pressure training with keeper Jodi Carrigan. *Photo by Adam K. Thompson/Zoo Atlanta.* Figure 9: Reverse sleeve viewed from keeper-side of mesh. *Photo by Jodi Carrigan.* Figure 10: Reverse sleeve viewed from gorilla-side of mesh. *Photo by Jodi Carrigan.*

Providing Optimal Wellness for a Captive Gorilla with Pica

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This year the San Francisco Zoo embarked on a Wellness Initiative with the help of Dr. Terry Maple, Research Professor at Florida Atlantic University and former Director of Zoo Atlanta, and the support of the Zoo's Board of Directors. While the San Francisco Zoo has had a long history of caring for animals to the best of our ability, with this Initiative we are highlighting and defining the optimal physical and psychological welfare of many of our animals, while also noticing which animals would benefit from a different approach. In order to provide excellent animal wellness, zoos must go beyond providing just the basics. The Zoo's wellness husbandry plan involves naturalistic enclosures that elicit wild behaviors, species-specific social groupings, purposeful enrichment, and medical training – all to provide our captive animals the best life possible. A wellness program challenge is to meet individual animal needs while also giving the group optimal care. An example of such a challenge is caring for Western Lowland Gorilla "Zura", a long-time resident at San Francisco Zoo.

Zura after laparoscopic surgery.
Photo by Kathy Edwards.

Zura was born at Columbus Zoo in September of 1981. She was hand-raised with her half-brother, Oscar Jonesie, and they transferred as a pair to the San Francisco Zoo when Zura was just over a year old. As a small gorilla with a poor appetite, Zura was encouraged and rewarded for eating. It is not certain when she developed a taste for foreign objects but it was early in her life and the behavior persisted. Zura's pica seemed to intensify during periods of stress, which may have occurred since she is the subordinate gorilla in the group.

Zura's consumption of non-food items is a behavior defined in the medical profession as pica, a compulsive disorder seen in humans and animals and characterized by eating non-nutritive substances or consuming food ingredients in an abnormal manner (Segans 2011). Environmental, social, biological and psychological factors can lead to compulsive disorder risk (Ansel 2004). The specific cause of pica is unknown, but stress may be a precipitating factor (ANRED 2012). Many human sufferers report stressors such as maternal deprivation, family issues, parental neglect, pregnancy, poverty, and disorganized family structure (Pediaview 2012). Pica becomes a way for an individual to escape stress. There are no known methods of preventing pica, but once diagnosed, measures can be taken to reduce further ingestion of the non-food substances by removing the substance (Pediaview 2012). It is also important to determine why the individual wants to escape a certain situation or activity, and then remove the individual from that situation or activity if possible (Dugan 2006). Pharmacological treatment and environmental enrichment have also been helpful in treating compulsive disorders (Dodman 2011).

By her mid-twenties, Zura's pica had manifested itself through consumption of a wide array of foreign objects. Some of the items passed naturally through her system, while others required laxatives, enemas, or even surgery for removal. Over the years, the diversity of enrichment items offered to the gorilla group was curbed, and then decreased yet again to combat the problem. By 2000, the gorilla group at the SF Zoo was not allowed to have any enrichment items made of paper, cardboard, cloth, thin plastic or rubber, and oat hay, straw, and timothy hay were similarly ruled out for the group due to Zura's obsessive consumption of these items. The only bedding option left for the group was excelsior, also known as wood wool. In an effort to treat idiopathic bouts of constipation, Zura received extra fiber drinks daily and her stool was monitored for foreign objects. This went on for six years.

In 2006, we started working with Dr. Orin Abrenson and Dr. David Shields, human doctors specializing in gastroenterology. Dr. Abrenson reviewed Zura's file and gave her a tentative diagnosis of Crohn's disease, for which she was prescribed Mesalamine, or Pentasa. While on the Pentasa she seemed to improve, or at least did not have any new episodes of impaction. It was also a period of decreased stress for Zura because a new female had been introduced to the group. In 2009, Dr. Shields reviewed Zura's Pentasa treatment and recommended tapering her off to determine whether or not the improvement was due to the medication or elevation in social status.

Zura. *Photo by Marianne Hale*

A baby was born into the group at the end of 2008, an event that greatly altered group dynamics. The infant had to be hand-raised, followed by a surrogate introduction and eventual integration into the gorilla group. Oscar Jonesie, a first time father, was on high alert after the successful integration which significantly increased stress in the group.

By 2010, keepers noticed that Zura was becoming constipated frequently, then passing very large, fibrous stools. One bowel movement weighed in at 1.8 kg! During these episodes Zura would have low appetite and energy levels. We would keep her separate, provide laxatives and extra fluids, and wait for her to defecate. Browse was temporarily discontinued with the hope that Zura's stools would soften. After several months of this pattern, Zura had lost about 10 kg and staff was concerned about her long-term health.

The vet staff consulted Dr. Shields again, and it was decided to perform a capsule endoscopy to image the small bowel, most of which is inaccessible to flexible endoscopes. In people, this procedure involves swallowing a capsule containing a miniature camera ("PillCam," Given Imaging, Inc.) which then takes pictures as it passes through the intestines and transmits the images to a receiver held on a belt on the patient's abdomen. Although Zura may well have swallowed the capsule, she might also have eaten the receiver belt so in her case the procedure required anesthesia. The capsule was maneuvered through the stomach and into the start of the small intestine using a flexible endoscope and she was maintained under anesthesia for the following five hours while the capsule moved through the intestine and transmitted its pictures to the receiver. Although the PillCam did not have time to pass through the full length of the small intestine during the five hours, all the images it obtained appeared normal. Similarly, all images and biopsies of the stomach, duodenum and colon obtained by flexible endoscopy were also normal so there was no evidence of Crohn's disease or any other primary intestinal disease identified. Zura was fasted for 36 hours prior to the procedure, and during this time she started to eat her excelsior bedding.

Zura's constipation continued and a laparoscopy (telescope inserted through the body wall to examine the surface of the abdominal organs) was scheduled with a human surgeon, Dr. Andrew Shelton, to determine the cause. The most prominent discovery from the procedure was a multitude of adhesions between the intestines and the body wall. These adhesions were probably the result of micro-perforations in the intestines caused when foreign objects were passing through her system. In order to stop any leakage, the intestines will "stick" to the body wall or other organs, thus forming a barrier, but also restricting movement within the tract. The adhesions were not inflamed, meaning that they were from previous traumas to her gut that had already healed. These adhesions had decreased Zura's gut motility making it more difficult for her to process even regular food items.

While it was illuminating to know what was causing Zura's intestinal issues, the procedure was invasive and required major changes to Zura's routine. A laparoscopy requires cutting through the abdominal wall which leads to a lengthy recovery period. Prior to the procedure, Zura needed to fast and was kept alone for two days. The healing process required Zura to be kept inside and separate from the group for another four days. During that recovery period, Zura kept eating excelsior, the only bedding that was previously safe for our gorilla group. We immediately replaced all excelsior from the gorilla building and yard with large quantities of browse for bedding.

Zura is now on a regimen of stool softeners, fiber and fluids. We give her glitter daily in order to monitor the consistency and quantity of her stool. Once a month we perform a gut transit time test with a different color of glitter. Zura's pica has caused lasting damage to her digestive tract; it now takes 36 hours to process her food, while the other gorillas require only 24 hours. The gorillas have been without bedding for over a year now, but we have started a slow process of reintroducing excelsior in the hopes that Zura will not ingest it. In the absence of bedding we have installed numerous hammocks, provided thick rubber tubs, and when possible gave them a large amount of browse for nest building. With a lot of brainstorming, keepers have come up with some good options for enrichment made out of metal or thick, hard plastic, as well as natural alternatives such as small amounts of alfalfa or varieties of browse.

Zura has been doing very well, socially and physically, and has been constipation-free for more than two years. When Zura is feeling well, she has a fun and engaging personality and is a favorite among staff and visitors. Zura is often seen checking out visitors, then waggling her tongue at them in play. Zura is also a wonderful auntie to young gorillas in the group; she will give them back rides or play gently with them

Excelsior removed from exhibit and bedding replaced by browse. *Photo by Kathy Edwards*

in a quiet space. It has been a long road of discovery to develop a wellness husbandry plan that works for Zura, but it seems that we are almost there. This year, windows were installed to prevent visitors from accidentally dropping objects into the exhibit, which has further limited Zura's access to non-nutritive substances. Husbandry for the entire gorilla group has been affected by Zura's needs, but we believe the group has benefited from Zura's lively personality as well.

ACKNOWLEDGEMENTS

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REFERENCES

ANRED. 2012. *Pica. Anorexic Nervosa and Related Eating Disorders Inc.*, np. April 30, 2012. *http://www.anred.com/pica.html*

Ansel, K. 2004. "Eating Disorders: Nutrition and Well Being A to Z" *Encyclopedia.com*, 2004. Accessed May 6, 2012. *http://www.encyclopedia.com/topic/eatingdisorders.apx*

Dodman, N. 2011. "Obsessive Compulsive Disorder in Animals" *Veterinary Practice News*, May 23, 2011. Accessed April 30, 2012. *http://www.veterinarypracticenews.com/vet-practice-news-columns/pet-projects/obsessive-compulsive-disorder-in-animals.aspx*

Dugan, S. and R. Frey. 2006. Pica. *Gale Encyclopedia of Medicine,* Third Edition. 2006. Accessed May 6, 2012. *http://www.encyclopedia.com/topic/pica.aspx*

Pediaview. 2012. Pica. *Pedia View*, np. Accessed April 30, 2012 *http://pediaview.com/openpedia/Pica_(disorder)*

Segans Medical Dictionary. 2011. Pica. Farlex Inc, 2011. Accessed May 6, 2012. *http://medical-dictionary.thefreedictionary.com/pica*

Zura playing auntie. *Photo by Marianne Hale*

Managing a Critically Ill Western Lowland Gorilla *(Gorilla gorilla gorilla)* with Cholangiohepatitis and Intestinal Hemorrhage During the Disease and Recovery Phases

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Lacey Byrnes, Senior Mammal Keeper
Wendy Anderson, Senior Mammal Keeper
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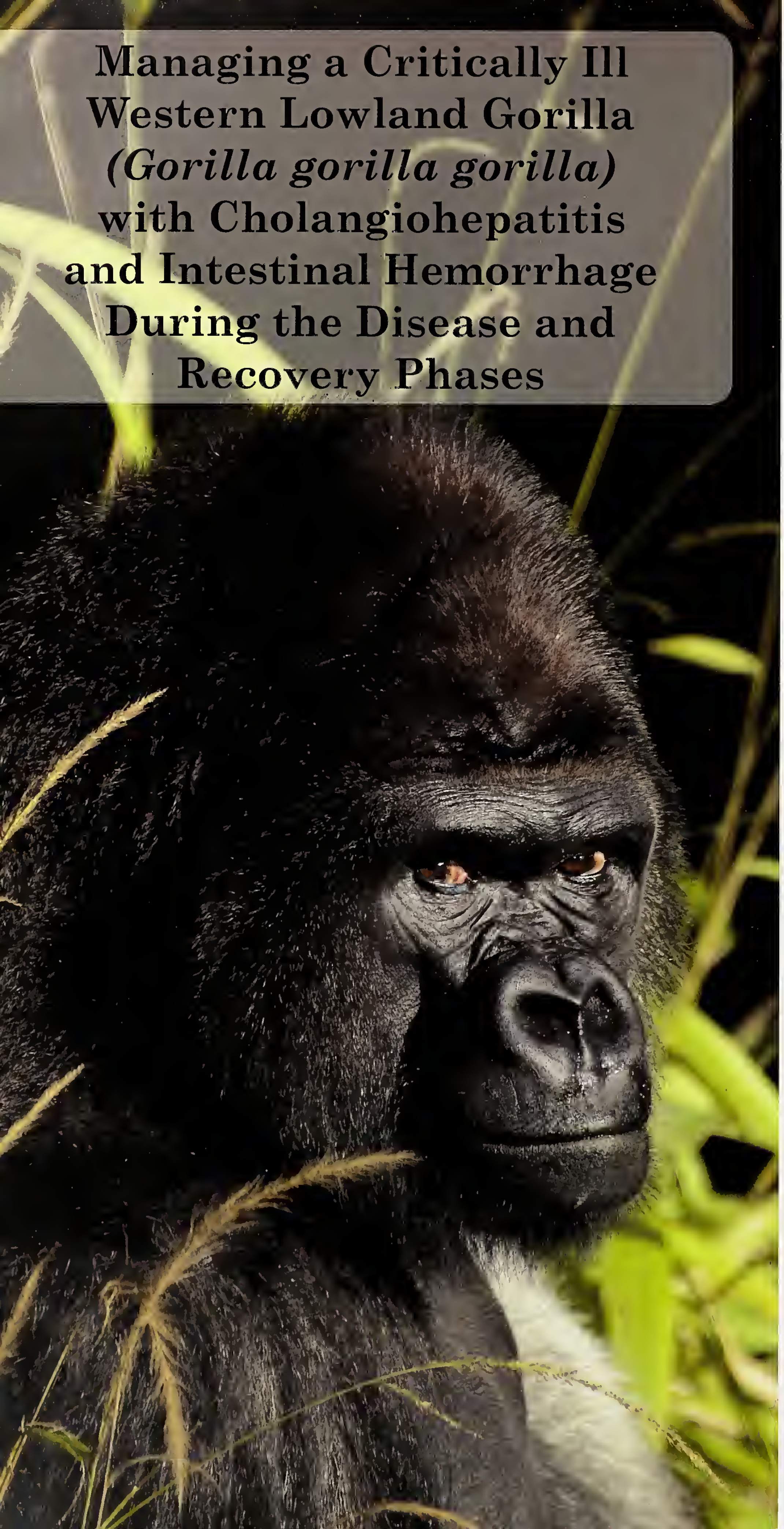
ABSTRACT

Goma is a 21-year-old Western Lowland Gorilla (*Gorilla gorilla gorilla*) that currently resides at the Santa Barbara Zoo with his half-brother, Kivu. On 12 June 2012, Goma began to display symptoms of a disease process that required veterinary and keeper staff to perform a total of five immobilizations over the course of 2.5 weeks in an attempt to diagnose and treat his illness. Many diagnostic tests were performed resulting in the diagnosis of cholangiohepatitis and intestinal hemorrhage, however the primary etiology for these disease processes was not determined. A blood transfusion and a series of medications were part of his treatment, as well as round-the-clock care from keeper staff, all of which resulted in his slow but successful recovery and regaining 28 kg that were lost during his illness.

INTRODUCTION

The Santa Barbara Zoo currently houses 2.0 Western Lowland Gorillas. Goma and Kivu, both 21-years-old, are half-brothers that were born at the Buffalo Zoo in 1991 and have been housed at the Santa Barbara Zoo since 1996. Kivu has been the dominant individual since the passing of the 3rd male in the bachelor troop, Max, in 2004.

The gorillas are managed together on exhibit during the day and are housed in separate holdings overnight. The configuration of their holdings is one holding upstairs and one downstairs (two stories) with a catwalk connecting the lower holding to a vertical shift door. The gorilla housed in the lower holding has access to the catwalk and can come upstairs and have visual access to the gorilla housed in the upper holding. Preventative medicine examinations performed under anesthesia were conducted yearly until 2010 and include physical examination, blood tests, dental examinations and cardiac ultrasounds. These examinations are now performed every two years. There are two primary gorilla keepers, Wendy Anderson and Lacey Byrnes, who are also responsible for the daily care of the Zoo's Masai giraffe (*Giraffa camelopardalis tippelskirchi*)



Goma on exhibit
Photo courtesy of Sheri Horiszny

herd and slender-tailed meerkat (*Suricata suricatta*) mob. Wendy Anderson has been working with the gorillas for the past five years, while Lacey Byrnes had become a primary gorilla keeper just weeks before Goma's illness. The Zoo's curator of mammals, Michele Green, is highly involved in the daily care of the gorillas and was previously one of the primary gorilla keepers at the zoo.

ONSET OF ILLNESS

On 12 June 2012, Goma was observed exhibiting signs of mild lethargy, decreased appetite, and shaking of his left arm when bearing weight. The following day, keepers continued to see a decrease in his activity and he selectively ate offered items, focusing on greens and fruit. A cold/flu suspension (acetaminophen, dextromethorphan HBr, phenylephrine HCl) was prescribed for the next two days, as Goma had a history of colds presenting with similar vague signs, although this time there was no nasal discharge.

On 14 June 2012, Goma developed cowpat stools with a moderate amount of mucus, was passing gas and appeared to have a slightly bloated abdomen. Goma was kept off exhibit and managed inside so that keeper staff could monitor his food/water consumption and observe his behavior closely. His face was glossy and he had problems shifting from the upstairs holding to the downstairs holding and back again for keeper staff to do their regular cleaning. This shifting involved him having to either hold his body weight as he descended or pull himself up through the vertical shift door in the catwalk. His generalized weakness was very apparent. Keepers continued to observe shaking and weakness of his left arm, particularly while he was bearing weight on that arm. He was also observed lying on his back with his feet in the air and squeezing his eyes shut tightly, which was suspicious of waves of abdominal discomfort. The cold/flu suspension was discontinued, as it did not appear to be helping. On 15 June 2012, Goma's symptoms had worsened. He was very depressed and would not sit up. He would only consume a few lettuce leaves and Gatorade® that was hand-fed to him while lying down. His urine was very concentrated and the cowpat stools continued. A primary enteritis/colitis was suspected and diarrhea secondary to another cause was also considered. He was started on ciprofloxacin, acetaminophen and probiotics. That afternoon, the decision was made to house him in the lower holding area where Kivu is normally managed overnight. Kivu was shifted into Goma's upstairs holding. The lower holding is divided into four separate bedrooms and is the usual location for medical procedures to be performed. The lower holding is adjacent to the primary keeper work area, so housing Goma downstairs made it convenient for staff to closely observe him, as well as allow Goma to be able to see staff and feel less isolated.

Keeper staff arrived on the morning of 16 June 2012 to find that Goma's condition was the same: very depressed, laying on his side and would not sit up and not eating or drinking. After re-evaluation by the veterinarian, the decision was made to anesthetize Goma for a full examination.

THE FIRST IMMOBILIZATION

On 16 June 2012, Goma was anesthetized for a diagnostic work-up. This included physical examination, blood collection, abdominal and cardiac ultrasounds, urine and fecal collection, and TB testing. Intravenous fluids, antibiotics and flunixin meglumine were given during the procedure. Goma's recovery from the procedure was extremely prolonged. It was two hours post-reversal before he could be extubated and there was only slight movement in his shoulder and forearm when stimulated four hours post-reversal. His respiration remained stable throughout this time. It was not until 12 hours after the end of the procedure that he sat up. It was suspected that the very prolonged recovery was caused by the administration of buprenorphine for pain relief just prior to recovery in combination with the use of tiletamine/zolazepam for anesthesia induction (pers. comm. Dr Hayley Murphy, Atlanta Zoo). During recovery he was positioned lying on his left side.

The following day he was still very lethargic and depressed, but he was moving around the stall and eating and drinking a little. He was not using his left hand and when moving around he was observed to be walking on his left wrist instead of his knuckles. No stools were observed. Blood results revealed lymphopenia, very low platelet count, mild hypoproteinemia, moderately elevated liver enzymes, very high total bilirubin, high direct bilirubin and high resting bile acids. Protein and bilirubin were found in the urine. The differential diagnoses included primary liver disease, biliary duct obstruction causing cholangiohepatitis, primary enteritis and/or thrombocytopenia. Ciprofloxacin was continued and ketoprofen and Vitamin K1 were commenced. Two human gastroenterologists were consulted regarding Goma's condition. The first gastroenterologist thought biliary tract obstruction due to gallstones was most likely, while the second gastroenterologist thought that primary hepatic disease was more likely but could not rule out biliary tract obstruction.

On 18 June 2012, Goma was more alert, sitting up and moving around, eating and drinking, and passed some firm stool. There was shaking of all his limbs when standing and he was still not using his left hand. Keepers saw him move his left thumb, as well as his left shoulder and elbow. Over the next three days Goma became mildly jaundiced and was lethargic with a mildly increased respiratory rate. He was sitting up, moving around, eating, drinking and passing cowpat stools. His abdomen was moderately distended and he would periodically lay on his back with his legs up against the wall and squeeze his eyes closed and sometimes pass gas. His limbs were shaking when standing and he was still walking on his left wrist and not using his left hand, although some movement of his fingers was observed. An episode of epistaxis from the left nostril (nose bleed) with significant blood loss was observed one morning. This raised the concern of thrombocytopenia, possibly immune-mediated, or coagulopathy secondary to liver disease. Plans were made to anesthetize him again for further examination.

During this time, keepers monitored Kivu's behavior closely. Goma was not given access to the exhibit due to his poor health. Kivu was managed on exhibit alone and he showed no signs of ill health.

THE SECOND IMMOBILIZATION

Goma was anesthetized again on 22 June 2012 for 3.5 hours to perform further diagnostics, which included a physical examination, blood collection for numerous tests, abdominal radiographs, abdominal ultrasound and ultrasound-guided liver biopsies, aspiration of bile and peritoneal fluid, bone marrow biopsies, urine collection, and fecal collection/rectal swabs.

Hematological findings included mild to moderately low red blood cell count, hemoglobin and hematocrit, and low reticulocyte count. The hemopathologist felt that this low reticulocyte count was not consistent with hemolytic anemia. Blood results also showed no evidence of coagulopathy or thrombocytopenia and there was significant neutrophil toxic change, indicative of an infectious/inflammatory process. Liver enzymes were still moderately elevated, while bilirubin and bile acids were increasing. Simian retroviral screening was negative. Hepatitis A (IgM) antibody and Hepatitis B surface antigen were both negative.

On examination, there was a lot of gas present in the intestines, which was causing abdominal distension. However, there was no evidence of biliary obstruction or gallstones. Inability to use the left hand was suspected to be neuropathic as no other causes were found on examination. Liver biopsy histopathology results indicated marked suppurative cholangiohepatitis, probably bacterial in origin but no organisms were isolated from microbiological culture of the liver biopsies. There was also no growth of organisms from the bile or peritoneal fluid. Medications were changed to amoxicillin trihydrate/clavulanate potassium and metronidazole. The ketoprofen and vitamin K1 were continued, while ciprofloxacin was discontinued.

The following day there was another suspected episode of epistaxis, but overall he seemed a little brighter and was eating and drinking. Liquid to cowpat stools continued and abdominal distension was still present. He moved around the stall slowly and keepers spent the majority of their day taking care of Goma, as he had to be hand-fed all food items. On 25 June 2012, his stools were still very soft and now very dark, possibly melena. By late afternoon, Goma appeared more depressed, had lost his appetite and was sweaty in his face. He was moderately jaundiced and his mucus membranes appeared paler. By the morning of 26 June 2012 he had deteriorated significantly. He was extremely weak and unable to sit up. His mucus membranes were very pale and he was passing bloody stools. Preparations were made to immediately anesthetize him again for a further work-up, with the understanding that there were significant risks involved in anesthetizing such an ill animal.

THE THIRD IMMOBILIZATION

Goma underwent a third procedure on 26 June 2012 and was anesthetized for four hours. Diagnostics included a physical examination, blood collection, abdominal ultrasound, bone marrow biopsies, endoscopic examination and biopsies of the stomach and colon. His hematocrit (HCT) and hemoglobin (Hgb) levels were critically low (8% and 2.7 g/dl respectively) having dropped from 32% and 9.5 g/dl respectively three days prior, indicating significant blood loss presumably from his gastrointestinal tract. During the examination, bloody stools were leaking from his rectum; his abdomen was no longer distended. Clotting times were normal. The reticulocyte count was still low but indicative of a regenerative anemia. Liver parameters were still elevated but improved from four days prior. The white blood cell count and differential continued to remain within normal limits. Endoscopic examination of his stomach and colon did not locate any obvious sources of bleeding. The colonic mucosa appeared moderately inflamed. There were no significant microscopic findings of the gastric and colonic biopsies. Normal gut flora continued to be isolated from fecal cultures. Intravenous fluids were given in addition to antibiotics and ketoprofen, and a fecal enema was performed using feces from his half-brother. A blood transfusion was determined to be the best course of action. Following a discussion with veterinary and animal care staff, the decision was made to proceed with a blood transfusion using his half-brother, Kivu, as the donor. Goma was maintained under anesthesia while preparations were made to immobilize the other gorilla. During this time, Goma started to experience significant anesthetic complications including respiratory arrest, so the transfusion procedure was aborted and Goma was woken up. His recovery was very slow again, taking 2.5 hours to start moving after reversal. Staff prepared themselves for the fact that Goma was likely not to survive the night and his longest standing caregivers, Wendy Anderson and Michele Green, stayed with him overnight. The following morning Goma was still alive but extremely weak. He was jaundiced, unable to sit up, had very pale mucus membranes and his bloody diarrhea continued. The decision was made to make a second attempt at performing a blood transfusion.

THE TRANSFUSION

Kivu was immobilized on the morning of 27 June 2012 and approximately 3.5 units of whole blood were collected and prepared for transfusion. No cross-matching was performed. In his critically ill state, Goma was anesthetized for the fourth time in order to receive the blood transfusion. He remained remarkably stable during the 2 hour and 20 minute anesthetic procedure and recovered quickly after reversal. The total amount of whole blood collected from Kivu was transfused into Goma over 75 minutes, followed by intravenous fluids. Frank blood was running out of his rectum for approximately five minutes shortly after the transfusion was commenced, then ceased. The pre-transfusion HCT was 8% and Hgb was 2.7 g/dl. The post-transfusion HCT was 13% and Hgb was 3.4 g/dl. Liver parameters were increased compared to the previous day. New medications were started, including azithromycin, omeprazole, sucrulfate, milk thistle, multivitamin tablets, Yunnan paiyau and probiotics. Amoxicillin trihydrate/clavulanate potassium and vitamin K1 were continued, while metronidazole and ketoprofen were discontinued.

The next day Goma was considerably improved. He was moving between stalls, and eating and drinking. His mucus membranes were pink but he continued to produce bloody stools. He became exhausted quickly after moving around and displayed behavior that indicated periodic abdominal pain. A liquid diet was commenced to rest the intestine.

Ongoing hemorrhage from the intestinal tract raised the concern that another blood transfusion might be needed. In this case, a different donor would be required and cross-matching of the blood would be necessary. Gorilla blood types are still unknown and the best donor would be an adult unrelated male (pers. comm. Dr Kathryn Gamble, Lincoln Park Zoo). A request was made to zoos in California for donated blood from any suitable healthy gorilla if undergoing an annual examination. The Los Angeles Zoo had an unrelated male gorilla (Kelly) that was due for an annual examination. Staff agreed to bring the examination forward and to collect blood to be donated. Santa Barbara Zoo veterinary staff traveled to Los Angeles to assist with blood collection during the procedure and four units of whole blood were collected. The blood was compatible on major and minor cross-matching.

Back in Santa Barbara, Goma continued to improve slowly each day post-transfusion. Fewer signs of abdominal pain were observed and his appetite improved. His stools remained very soft but changed from bloody to coffee ground in appearance over three days. After two days of a liquid diet, easily digestible food items (high carbohydrate/low fiber) were introduced. By 2 July 2012 he was walking on his left knuckles and using his left hand well. Shaking of his limbs was still observed when weight bearing. His stools continued to be soft and coffee ground in appearance, but no red blood cells were seen on fecal cytology.

On 3 July 2012, Goma was immobilized again (one week post-transfusion) to recheck hematology and chemistry values to determine if the second transfusion was needed. He was anesthetized again (for the 5th time), for 1 hour 30 minutes and recovered normally. The jaundice had resolved. His HCT was 18% and Hgb was 4.8 g/dl, and the reticulocyte count was much improved, indicating good bone marrow response to the blood loss. Liver parameters were mildly elevated but had improved significantly. Abdominal ultrasound and endoscopic examination

Goma anesthetized for diagnostic procedures. *Photo courtesy of the Santa Barbara Zoo.*

of the stomach, duodenum and colon were performed and no abnormalities were found. Gastric and duodenal biopsies were collected and there were no significant microscopic findings. Based on the rising HCT, good reticulocyte response and clinical improvement, it was decided not to perform the second transfusion as the risk of a transfusion reaction, despite cross-matching, potentially outweighed the benefit.

Goma continued to show daily improvement with some minor setbacks. He developed an intestinal yeast overgrowth that was treated effectively with nystatin. By 10 July 2012 he was very active, moving well, and still had shaking of his limbs when standing. The cowpat stools persisted but the color had improved. He started to regurgitate and re-ingest specific starchy food items so regular food items with increased fiber were introduced. He was returned to his normal diet over a period of three days and the regurgitation stopped. He had lost 28 kg in the last month.

Over the next two weeks he was given an increased volume of his normal diet. His overall clinical condition improved along with slow weight gain, but there was persistence of liquid to cowpat stools that were green in color. Two strains of *E. coli* were isolated on fecal culture, and his stools improved within two days of commencing a course of enrofloxacin. By 02 August 2012, Goma was doing very well. His stools were normal and he had gained back a good portion of the condition he lost during his illness. Re-introductions to his half-brother were initiated and continued slowly. Both Goma and Kivu were successfully managed back on exhibit together three weeks later.

On 02 December 2012, after an altercation between Goma and Kivu that resulted in significant bite wounds, both gorillas were prescribed oral sulfamethoxazole/trimethoprim antibiotics and topical antiseptic spray to treat their wounds. Goma received 60% of his first dose of sulfamethoxazole/trimethoprim and 30 minutes later had a significant allergic reaction to the medication. He was sweating profusely from his armpits, was scratching his limbs and face, and swelling around his eyes and mouth developed. After being given a corticosteroid and diphenhydramine orally, the reaction subsided. Goma was changed to a different antibiotic (amoxicillin) and completed his seven-day course without any further adverse reactions. Following the reaction, Goma's abdomen appeared distended. He was also observed regurgitating and re-ingesting his medicated bananas. The reaction to the sulfamethoxazole/

trimethoprim was unexpected, as he had received the medication in the past without incident.

It is now more than 18 months since the onset of his illness and Goma appears to have made a full recovery. Goma does have bouts of soft stool intermittently and shaking of his left arm is still observed, particularly when he becomes very active or is displaying. Keepers have also observed that he does not appear to have the same upper body strength that he had prior to becoming ill. The etiology of the cholangiohepatitis was never determined, nor was the location of intestinal hemorrhage, however he made a remarkable recovery. Goma's astonishing compliance and responsiveness to his primary keepers, even at his most critical stage, had a large part to play in his eventual recovery.

(Pictured above) Goma eating a pumpkin on exhibit.
Photo courtesy of Sheri Horiszny.

Goma's illness and recovery phases required intensive management from both veterinary and animal care staff. It took a team of veterinarians and veterinary specialists, human specialists and keeper staff to provide care for him. Goma underwent five anesthetic procedures over 2.5 weeks, he was constantly monitored, and his keepers spent many days by his side hand-feeding him food and fluids. There were a large number of medications prescribed (not all listed in this paper) that at times were being given as often as five times per day. Medications were constantly changing, as were the dietary instructions. Goma's primary keepers provided him with many hours of direct interaction for mental stimulation due to his weeks of isolation indoors, as well as continuing to care for other animals in the area. This was reflected in the more than 100 hours of keeper's overtime logged during this time. The rest of the animal care team and all departments within the zoo rallied together to support his primary keeper staff and veterinary staff while they were consumed with Goma's care, and continued to provide care to the rest of the collection.

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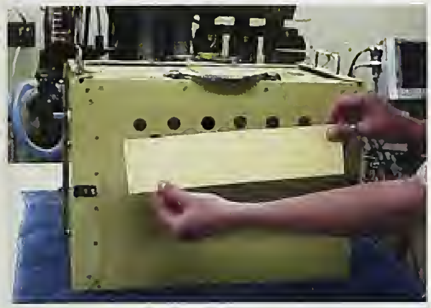

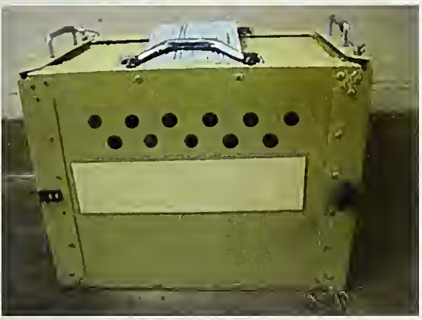

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